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Evidence for Parthenogenesis in the Featherwing Beetles, with a Taxonomic Review of a New Genus and Eight New Species (Coleoptera: Ptiliidae).

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INTRODUCTION

The new genus *Eurygyne* is a distinctive group of tiny featherwing beetles that is widespread in tropical and subtropical areas of the world. Though no members of the genus have been recorded previously from the United States, they seem to be rather abundant, especially in Florida where seven new species occur. The beetles are trim little forms, about 0.6 mm. long, that live in decaying organic materials in the floor stratum. There they presumably feed on spores and hyphae of fungi, as do other members of the family. In some situations they may become very numerous, though only one relatively huge egg is matured in the abdomen at a time.

Parthenogenesis has not been reported previously in the Ptiliidae, but evidence for complete parthenogenesis is presented for at least five of the eight new species of *Eurygyne*, and some possible reasons for its high incidence are suggested. One of the parthenogenetic new species has an anomalous geographical and ecological distribution in the United States, which is discussed later.

The Bahama Island form, in contrast to all the mainland species, is polymorphic with respect to the wings; most of the individuals have the expanse of the featherwing greatly reduced by the loss of most

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of the long marginal wing hairs, presumably as an adaptation against being passively wafted out to sea.

The eight new species are all from the United States and the adjacent Bahamas and from Bermuda. Other undescribed species occur in the New World and Old World tropics. Five nominal species from the Old World, described in the genus *Throscidium*, very probably belong to *Eurygyne* and are transferred to the genus though they cannot be identified from the descriptions.

MATERIALS AND METHODS

In a group of insects as tiny as the Ptiliidae, appropriate techniques of collecting and sampling, of sorting and handling, and of study and illustration, are especially important. I plan to treat these techniques in a later paper; but it is adequate for the present to say that the taxonomic treatment in this paper is based on structures that cannot be studied from the traditional dry mounts, using stereoscopic microscopes and reflected light. There are external differences between the new species described in the following pages, but I have not used these differences for taxonomic purposes to any extent for two main reasons which apply to the Ptiliidae in general. First, the beetles are too small to study with the maximum magnifications and illumination practical with stereoscopic microscopes. Details of the antennae, legs, mouthparts, and other structures cannot be seen or analyzed well. Second, many of the differences that can be seen—slight species differences in color, pubescence, and general facies—cannot be accurately communicated to other biologists either through illustrations or through descriptions.

The only basis for a sound taxonomy in this genus, as in most Ptiliidae, lies in structures, like those of the antenna and spermatheca, that can only be studied and illustrated accurately from material mounted on microscope slides. In *Eurygyne*, the spermatheca has proved useful in differentiating the species. Constant differences characterize species that would be difficult to separate on the basis of external characters. A good example is furnished by *E. frosti* n. sp. and *E. suteri* n. sp. which are similar brown species externally, but which differ in the form of the spermatheca. A complex spermatheca like that in *intricata* is not easy to interpret and illustrate, since it is only about 0.1 mm. in greatest dimension. In the species with a simpler spermatheca, where slight variations in form can be readily detected, there is remarkably little variation within a species. In *frosti*,

lutea, and *fusca* (fig. 4), for example, I have examined, respectively, 370, 2,500, and 630 females without seeing any variations which did not fall clearly within one of the three spermathecal types.

This study is based upon about 11,400 specimens from the United States and another 600 specimens from the adjacent Bahamas and Bermuda. Except for *E. lutea* n. sp., all of the specimens of *Eurygyne* were studied on permanent slide preparations (Euparal mounting medium) or on temporary mounts (Hoyer's medium). In the case of *E. lutea*, the number of specimens was so large (in excess of 9,100) that they could not all be prepared as microscope slide mounts. In this case, the smaller lots were completely mounted, while the larger lots, all from Florida, were sampled after inspection in alcohol. Since *E. lutea* can be readily separated from the other presently known Florida species by its color and general facies, and by the triangularly acuminate coxal lamina of the hind leg, I believe the sampling procedure introduced no significant taxonomic or numerical error. About 2500 specimens (more than 25% of the entire sample) were studied on microscope slides, mostly in Hoyer's medium. Temporary media are useful for thinly sclerotized and lightly pigmented forms like most of the *Eurygyne* species, and they require much less time for slide preparation. The data on egg size and number were obtained from temporary mounts; the KOH stage in the preparation of permanent mounts destroys the egg. After study of the temporary slides, selected specimens were processed for permanent slides and the rest of the specimens were returned to alcohol vials.

Unless otherwise stated (e.g., "sifting . . .," "at light") the specimens reported in this paper were extracted by means of the insect (Berlese or Tullgren) funnel. The use of this technique permits, for the first time, the systematic sampling for Ptiliidae of the microhabitats in an area and the accumulation of adequate series for study.

Where the size of the series permits, specimens of the new species of *Eurygyne* described in this paper are to be deposited in the following collections: American Museum of Natural History (AMNH), British Museum (Natural History) (BM), Canadian National Collection (CNC), Illinois Natural History Survey (INHS), United States National Museum (USNM), and the collection of Eivind Sundt, Svartskog, Norway.

THE FEATHERWING AND FLIGHT

Some data on the metathoracic wings are presented later in the paper and a preliminary description of the wing is desirable as it has

not been adequately described in the literature. The metathoracic wings in *Eurygyne* and in most Ptiliidae show a characteristic featherwing structure which is convergent in a number of unrelated groups of minute insects, notably Hymenoptera of the family Mymaridae. The wing (fig. 8) consists of a very narrow, heavily sclerotized basal strut and a much longer, narrow, membranous terminal portion which has no distinct wing veins but which has thickenings in the membrane. There is no thickened costal margin. The surface of the membrane has patches of microtrichia. The membrane of the wing is furnished with long marginal hairs which form the greater part of the expanse of the wing. There is an interruption in the array of marginal hairs, delimiting a terminal group from the proximal groups of the anterior and posterior margins. Just before their sockets in the membrane, the hairs are nearly transparent and are flexible (fig. 10a). When the wings are folded under the elytra, the hairs are appressed along the membrane and show through (in pale species) as dark vittae on each side. The wing folding pattern in *Eurygyne* is the same as described by Forbes (1926) for the genus *Acrotrichis*, which is in a different subfamily of Ptiliidae. There are no longitudinal folds as in most other beetles (Forbes, 1926), but only transverse folds, presumably because the membrane is very narrow. The first transverse fold is at the junction of the basal strut and the wing membrane. As in *Acrotrichis*, the folds are convex—concave—concave—convex (fig. 10b). This pattern may therefore be characteristic of most Ptiliidae except *Nossidium* and related genera, which have two parallel struts in the basal portion of the wing, a much wider wing membrane, correspondingly shorter marginal hairs, and a more complex wing-folding pattern (Forbes, 1926).

The convergent evolution of the featherwing in the most minute members of unrelated groups suggests that the featherwing structure is associated with the evolution of small size. It has been suggested by a number of authors (cf. Barber, 1924) that the featherwings function for passive dispersal, as in the ciliate seeds of plants.

Two main explanations for the evolution of the featherwing have been advanced. Rensch (1948) points out that in the evolution of small size in the Diptera, the thorax fills with flight muscles until finally a limit is reached when the thorax can no longer contain the necessary muscles and normal flight is no longer possible. He regards the convergent ciliated wing in Thysanoptera, Mymaridae, Trichogrammatidae, Ptiliidae, Sphaeridiidae, Clambidae, and minute Diptera, as an adaptation which enables the insect to make use of the viscosity of the air and to float.

Horridge (1956), on the other hand, points out that size is involved in the aerodynamics of an aerofoil like an insect wing. He concludes that the featherwings of Mymaridae and Ptiliidae are "operating in the range where the viscous drag forces are several times any possible lift forces. It is probable that they have abandoned altogether the aerofoil action and that they literally swim in the air." He points out that flight is still possible if there is some mechanism by which drag on the upstroke is less than that on the downstroke, for example, if the wings or bristles bend more easily on the upstroke than the down. In any case, such flight would be effective only over microdistances in still air, and passive dispersal by air-currents would seem to be the most important means of dispersal.

Eurygyne, new genus. Figures 1-14.

Throscidium auct. (nec Matthews 1872)

Type-species.—*Eurygyne intricata* new species.

Diagnosis.—A genus of Ptiliidae of oval, compact form with the hind coxae broadly laminate, nearly contiguous. Prosternum extremely short in front of the anterior coxae, which are very prominent. Mesosternum with a sharp median keel anterior to the mesocoxae; the keel does not reach the anterior border, which is delimited as a distinctly defined collar by a fine line. In one group of species, the collar extends onto the mesopleural humeri. The sutures lateral to the mesocoxae are straight, directed very slightly anteriorly, and are marked internally by a heavy endoskeletal ridge. Metasternum rather short, without 'metasternal lines'; produced between the hind coxae as a single pointed process. Abdomen without teeth at apex. Eyes emarginate behind and furnished with a dorsal flange, forming a pocket into which the anterior pronotal angles fit when the head is retracted. Femora of all legs narrowly laminate. Eyes well developed. Males unknown in some species. Distribution primarily pan-tropical and subtropical.

Description.—Form oval or elongate oval; head, pronotum, and elytra fairly smoothly contoured when body is contracted. Head large, broad, inserted into the pronotum to the eyes. Eyes large, prominent ventrally, emarginate behind, modified dorsally into a backward projecting flange which, together with the emargination, receives the anterior angles of the pronotum when the head is retracted. Antennae moderately long, 11-segmented; middle segments sub-cylindrical, elongate (shorter in *E. wagneri*), each slightly constricted at base and apex; segments 9-11 forming a loose, moderately enlarged club; segment 9, and more markedly segment 10, constricted beyond middle, vase-shaped. Mentum large, trapezoidal, sides slightly sinuate near base.

Pronotum broader than long, sides evenly curved; basal angles not noticeably prolonged; basal margin bisinuate near posterior angles, partly covering base of elytra and the triangular scutellum.

Elytra long, humeri with a slight angulation; epipleurae extending about half the elytral length.

Prosternum extremely short anterior to the coxae, which are very prominent.

Mesosternum short in front of coxae, extending little more than their greatest diameter; with a sharp median keel that does not reach the anterior border. The anterior border is delimited by a fine line as a distinctly defined collar. In one group of species (*wagneri* group), the collar extends onto the mesopleural humeri. Mesopleural humeri prominent, rounded, without a dentate projection. Mesocoxal acetabula broadly contiguous, the lateral sutures rather straight; directed slightly anteriorly, and marked internally by a heavy endoskeletal ridge (less developed in *steeresi* n. sp.). Metasternum short, about four times as broad as long; terminating between the hind coxae as a short pointed process (not bifurcate as in the *Nanosellini*). Metendosternite as in Figure 1b.

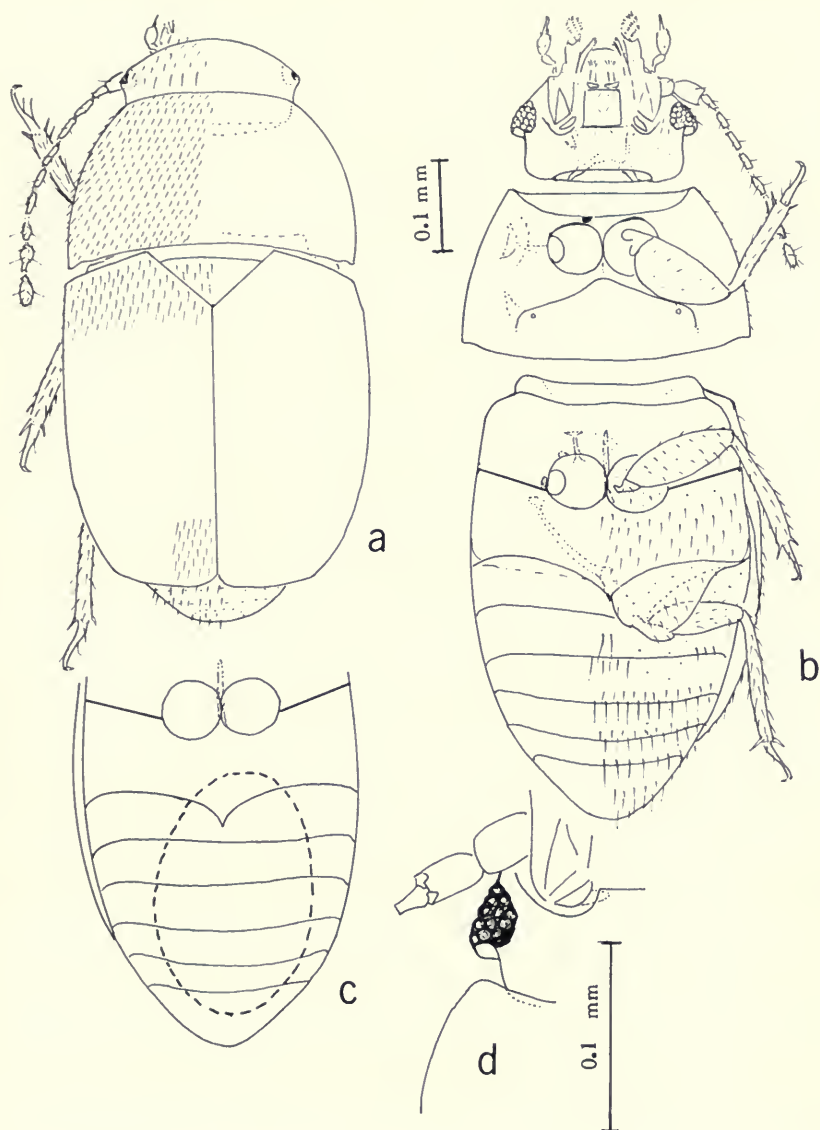
Abdomen nearly covered by the elytra, last segment partly exposed; 10-segmented; tergites I-V membranous or lightly sclerotized, II-V with the characteristic 'fingerprint' whorl pattern on each side; tergites I-VIII with a spiracle on each side; tergite VII with posterior margin micro-pectinate; tergite X well developed, separated from IX by a distinct straight suture, not dentate at apex. No sclerotized internal glands or row of 'glandular' pores (as in the *Pterycini*) visible. Sternite III, which is interpreted to be the first visible sternite, is somewhat carinate between hind coxae. Sternite IX in the female is an arcuate sclerite concealed by VIII; in the male (where the male sex is present) it can be detected internally as a spur projecting anteriorly to one side of the aedeagus.

Legs moderate in length; posterior coxae very broadly, subtriangularly laminate; anterior coxae relatively large, all femora with a narrow lamina. Anterior tibiae with one large spine at outer apex and two large spines before inner apex; tarsi slender, with slender subequal claws that bear a seta between.

Spermatheca tubular, varying from a simple U-shaped tube (cf. *E. lutea* n. sp.) to a highly coiled structure whose details are difficult to unravel (cf. *E. intricata* n. sp.).

Aedeagus (in species with males) tubular; no ventral hooks present.

Remarks.—The genus is distinctive and does not seem to be closely related to any other described genus in the *Ptiliidae*. In addition to the eight new species described in this paper from the eastern United States, the adjacent Bahama Islands, and Bermuda, five other nominal species that were formerly placed in *Throscidium* of authors (not Matthews, 1872) are tentatively assigned to *Eurygyne*. These species are *invisibilis* Nietner, *elongatula* Mots., *testaceum* Britten, *brunneum* Britten, and *nidicola* Paulian. The genus *Throscidium* Matthews, 1872, is thus left with only the two originally included species, *germaini* Matth., and *fairmairi* Matth. from Chile. The genus *Throscidium*, as restricted here by me, differs from *Eurygyne* in a number of characters, following Matthews' original description and figures



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FIG. 1. *Eurygyne intricata* n. g. and sp. a, dorsal view. b, ventral view. c, egg. d, ventral view, enlarged, showing dorsal flange of eye.

(I have not seen any specimens): The pronotum has the posterior angles produced, the abdomen is tridentate at apex, the mesosternal carina is bifurcate anteriorly and reaches the collar, the femora are broadly laminate at apices, and the metasternum is proportionately longer. These differences clearly preclude the inclusion in *Throscidium* Matthews, 1872, of the species here assigned to *Eurygyne* n. g.

None of the five described species transferred from *Throscidium* can be certainly identified from the descriptions, but they are very probably congeneric with *Eurygyne*, and they thereby extend its distribution to Ceylon, the Seychelle Islands, Cape Verde Islands, Panama, Guatemala, and the Ivory Coast. There is also much unstudied material, mostly in Field Museum of Natural History, that supports the pattern of pantropical geographic distribution. There are extensive series from Middle and South America especially, but also from Angola, the former Belgian Congo, Thailand, and other regions. Judging from preliminary microscope-slide samples of these collections, the genus will contain numerous species once it is studied with appropriate techniques on a world-wide basis.

The eight new species fall into two well-defined species groups. The *intricata* group is characterized by the mesosternal collar being restricted to the neck and not extending onto the mesopleural humeri (fig. 6d). The included species are *intricata* n. sp., *lutea* n. sp., *fusca* n. sp., *frosti* n. sp., *suteri* n. sp., and *steevesi* n. sp. In the *wagneri* group, the collar extends onto the mesopleural humeri (fig. 6c). Included species are *wagneri* n. sp. and *contorta* n. sp.

The following is a brief historical resumé:

1857. Nietner described *Trichopteryx invisibilis* n. sp. from Ceylon.
1867. Wollaston recorded *Acrotrichis* (= *Trichopteryx*) *invisibilis* Nietner from Cape Verde Islands (based on an identification by Rev. A. Matthews).
1872. Matthews described *Throscidium* n. gen. based on *germaini* n. sp. and *fairmairi* n. sp. from Chile. No type of genus designated.
1884. Matthews transferred *Trichopteryx invisibilis* Nietner to *Throscidium*. *Acrotrichis elongatula* Motsch. (1868), described from Panama, was listed as a synonym.
1888. Matthews, in the *Biologia Centrali Americana*, listed the distribution of *Throscidium invisibile* Nietner as Guatemala, Panama, Ceylon, and Cape Verde Islands. A figure (Pl. III, fig. 25) of the general habitus was given.

1926. Britten described two new species from the Seychelle Islands: *testaceum* and *brunneum* n. spp.

1952. Paulian described *nidicola* n. sp. from the Ivory Coast.

KEY TO THE SPECIES OF *EURYGYNE* IN THE UNITED STATES AND THE ADJACENT BAHAMAS AND BERMUDA

1. Ptiliidae with the hind coxae contiguous, or nearly so, mesosternum with a sharp keel that does not reach the anterior margin, and with a sharply delimited anterior collar; abdomen not dentate at apex; prosternum extremely short in front of coxae; eyes emarginate behind and furnished with dorsal flange, receiving the anterior angles of the pronotum when head is retracted; elytra long. *Eurygyne* Dybas, n. g. 2.
- 1a. Without the above combination of characters. . . other genera of Ptiliidae (not keyed).
2. Mesosternal collar extending onto mesopleural humeri (fig. 6c).
(*wagneri* group) 3.
- 2a. Mesosternal collar not extending onto mesopleural humeri (fig. 6d).
(*intricata* group) 4.
3. Spermatheca as in figure 5b, c. Antennal segments shorter (fig. 5a); color pale; male with a fovea on the frons. *E. wagneri* Dybas, n. sp.
- 3a. Spermatheca as in figure 6b. Antennal segments longer (fig. 6a); color dark; male sex unknown. *E. contorta* Dybas, n. sp.
4. Spermatheca with numerous coils (fig. 2b, c). A yellow species; posterior margin of pronotum not sinuately notched near the angles; male sex known.
E. intricata Dybas, n. sp.
- 4a. Spermatheca with only one or two loops; posterior margin of pronotum sinuately notched near the posterior angle; male sex unknown. 5.
5. Yellow; apex of hind coxal lamina acuminate; spermatheca as in figure 4c.
E. lutea Dybas, n. sp.
- 5b. Brown or fuscous; apex of hind coxal lamina rounded, spermatheca not as in 5. 6.
6. Spermatheca as in figure 4a *E. fusca* Dybas n. sp.
- 6a. Spermatheca as in figure 4f *E. frosti* Dybas n. sp.
- 6b. Spermatheca as in figure 7a, b *E. suteri* Dybas n. sp.
- 6c. Spermatheca as in figure 7c *E. steevesi* Dybas n. sp.

***Eurygyne intricata*, new species. Figures 1a-d; 2a-e; 3a-c; 9; 11; 13.**

Color yellow above and beneath; eyes dark; body covered with fine inclined golden setae. Posterior margin of pronotum not sinuately notched near posterior angles. Suture lateral to mesocoxae heavily ridged internally. Metathoracic wings polymorphic with respect to the number of marginal hairs. Form and chaetotaxy of antennae and of legs as figured (figs. 2a; 3a-c). Mesosternal collar not extending onto mesopleural humeri. Female with a distinctive, much coiled spermatheca (fig. 2b-c). Male aedeagus in the form of a tube (fig. 2d), its internal sac with

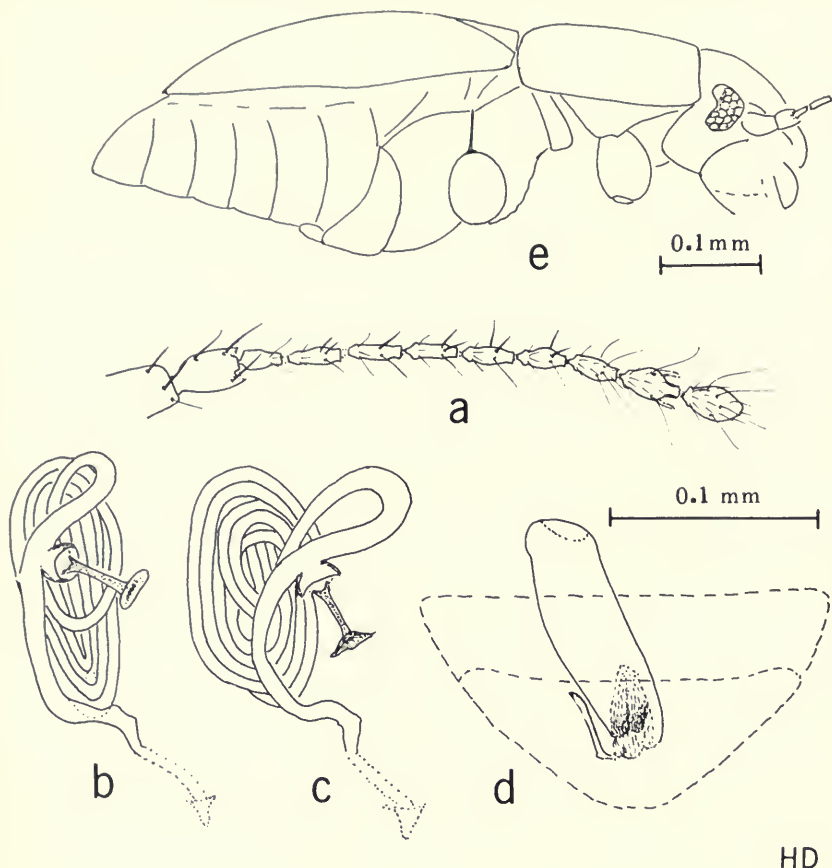


FIG. 2. *Eurygyne intricata* n. g. and sp. *a*, antenna, male. *b*, spermatheca, dorsal view. *c*, spermatheca, dorsal view, showing coils a little displaced. *d*, aedeagus, ventral view. *e*, lateral view, showing emargination in eye which receives the anterior angle of the pronotum when the head is retracted.

heavy sclerotizations which are visible through the walls of the aedeagus. No other secondary sexual modifications noted.

Measurements: About .52 mm. long from the anterior margin of the pronotum to the apex of the elytra; width about .33 mm. in slide-mounted specimens. In dry-mounted specimens, the total length from the tip of the retracted head to the apex of the abdomen is about .60 mm. long and .32 mm. wide.

Holotype.—A female, mounted on a microscope slide, from South Bimini Island, Bahama Islands, collected August, 1951, by C. and P. Vaurie. In the collection of the American Museum of Natural History.

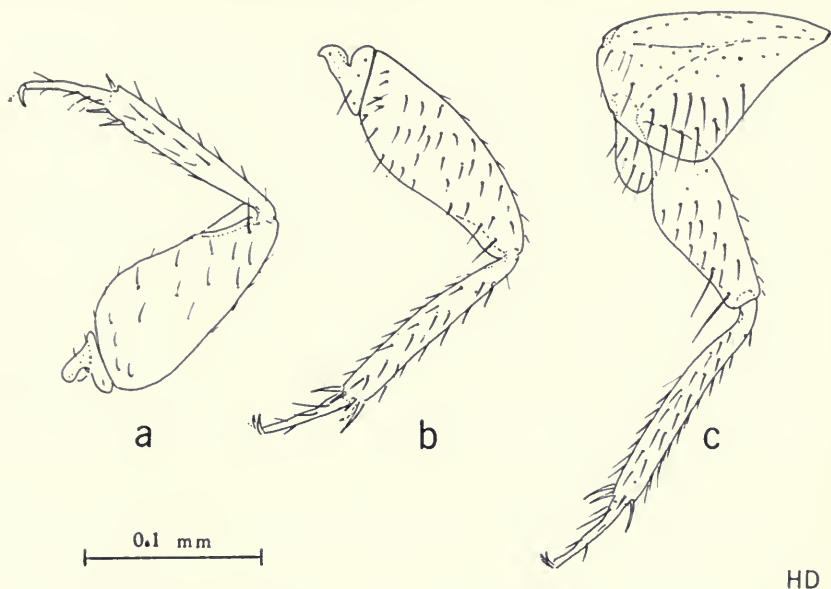


FIG. 3. *Eurygyne intricata* n. g. and sp. a, anterior leg, female, posterior face. b, middle leg, female, anterior face. c, posterior leg, female, anterior face.

Allotype.—A male, same data as the holotype. In the collection of the American Museum of Natural History.

Paratypes.—Same data as holotype, 116 ♀ ♀, 82 ♂ ♂; same data except June, 1951, collected by M. Cazier and C. and P. Vaurie, 59 ♀ ♀, and 58 ♂ ♂; same data except July, 1951, collected by C. and P. Vaurie, 158 ♀ ♀, 109 ♂ ♂. Paratypes in the collection of the American Museum of Natural History and Field Museum of Natural History.

Remarks.—*Eurygyne intricata* resembles *E. lutea* most closely in general appearance, but that species is slightly larger, the eyes are larger ventrally, and the posterior coxae are distinctly more acuminately triangular than in *intricata*. The specific name *intricata* refers to the intricately coiled spermatheca, which easily distinguishes this species from *lutea* and the other species in the *intricata* group.

The sex ratio, based on 582 sexed individuals, of which many are fragmentary, is 249 ♂ ♂ (43%) and 333 ♀ ♀ (57%). Of the 333 females, each of 76 (23%) had a single relatively huge egg in the abdomen. The egg measurement (from 24 measured eggs) averages .31 by .18 mm. The size of the egg precludes the maturation of more than one egg at a time in the abdomen.

The metathoracic wings show an unusual kind of polymorphism hitherto unreported in the family. In most of the individuals there is a great reduction in the number of long marginal wing hairs that normally account for much the greater part of the total wing expanse in the Ptiliidae. An extremely reduced wing of *intricata* has a fairly normal basal strut and terminal membrane, but the hairs in the terminal group may number only ten or less (fig. 9) whereas seven individuals with well-developed wings (of a sample of 107) averaged 50 hairs (fig. 11). Variation in the number of hairs in the anterior and posterior proximal groups was concomitant with that of the terminal group. This strong polymorphism and great variability contrasts sharply with *E. lutea* (fig. 11) and the other mainland *Eurygyne*, all of which have full complements of marginal wing hairs and show little variability. Additional remarks on the wing polymorphism are deferred until the *Discussion*.

There is no obvious reason, unless it be ecological, why this species should not yet be found on the Florida mainland. South Bimini Island is only 60 miles off the coast of Florida, and the prevailing southeast breezes during the summer should facilitate dispersal of the fully-winged individuals of *intricata* to suitable habitats on the Florida coast.

A description of the type locality and collecting activities is given by Vaurie (1952). Collected along with *Eurygyne intricata* were 12 female specimens of *lutea*, one female of *frosti*, large series of an *Acrotrichis* sp., several species of *Actidium*, and a few *Micridium* sp. According to Vaurie (1952), "The Ptiliidae were the most numerous Coleoptera taken. So many of them were in the debris from the Berlese funnels that when the alcohol vials in which they were collected were shaken the beetles formed a black cloud."

***Eurygyne lutea*, new species.** Figures 4c, d; 8; 10a, b; 11; 12.

Color yellow above and beneath. Body covered with fine inclined golden setae. Similar to *E. intricata* in form and in general appearance, but slightly larger and the eyes more prominent ventrally. Collar of mesothorax not extending onto humeri. The apex of the triangular metacoxal lamina is more acute than in *E. intricata*, and in the other species of the genus. Female spermatheca a simple U-shaped tube of diagnostic form (fig. 4c, d). Male sex unknown.

Measurements: in slide prepared specimens, about .58 mm. long from the anterior margin of the pronotum to the apex of the elytra. In dry-mounted specimens, the total length from the tip of the retracted head to the apex of the abdomen is .58 to .63 mm.; the width is .32 to .34 mm.

Holotype.—A female, mounted on a microscope slide, from Palma Vista Hammock, Everglades National Park, Dade County, Florida,

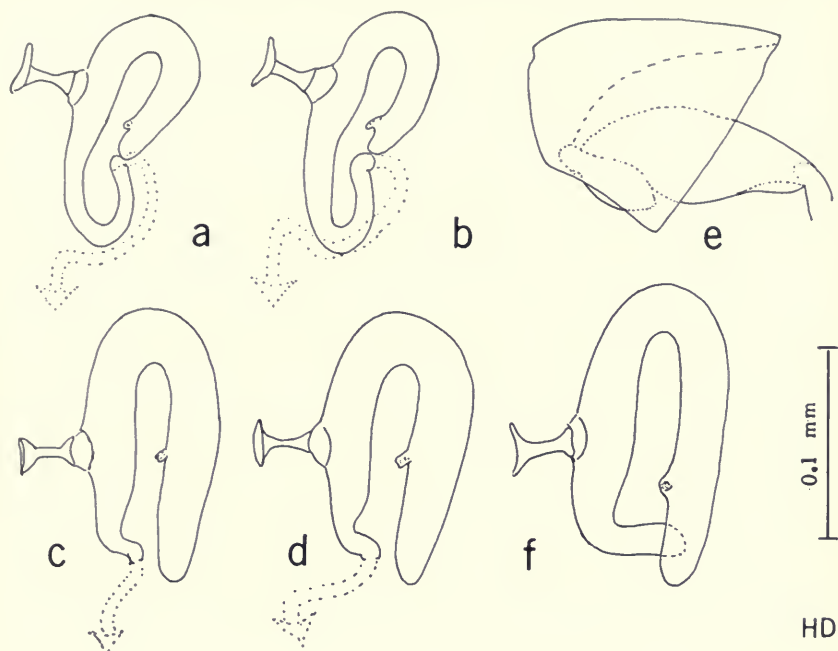


FIG. 4. a, *Eurygyne fusca* n. sp., spermatheca (Alabama) ventral view. b, spermatheca (Illinois), ventral view. c, *Eurygyne lutea* n. sp., spermatheca (Alabama), ventral view. d, spermatheca (Florida), ventral view. e, posterior coxa. f, *Eurygyne frosti* n. sp., spermatheca, ventral view.

collected August 27, 1965, by Walter Suter, "floor-litter at buttress of large tree." In the collection of Field Museum of Natural History.

Paratypes.—414 females, same data as holotype. In the collection of Field Museum of Natural History.

Other records.—FLORIDA: ALACHUA COUNTY, Island Grove, palmetto-cypress-maple swamp, Aug. 22, 1965, W. Suter leg., "litter at log with *Passalus*," 19 ♀ ♀; "litter in palm-cypress buttress," 31 ♀ ♀; "debris under palmetto frond," 3 ♀ ♀; same, but at Orange Grove, H. R. Steeves, Jr. leg., "debris at swamp edge," 32 ♀ ♀; 5 miles E. of Micanopy, Aug. 22, 1965, W.S.¹ leg., "peripheral litter on sawdust pile in buttress of oak," 38 ♀ ♀; Gainesville, pine-yellow poplar-magnolia ravine forest, Aug. 22, 1965, W.S. leg., "debris in buttress of yellow poplar," 6 ♀ ♀; "debris at pine buttress," 25 ♀ ♀; "forest floor at log in lowland along stream," 108 ♀ ♀. BAKER COUNTY,

¹ Hereafter W.S.=Walter Suter.

5 miles N. of Macclenny, Aug. 2, 1965, H.R.S.¹ leg., "debris under palmettos and scrub," 2 ♀ ♀; Aug. 18, 1965, W.S. leg., "pine-palmetto buttress debris on river bank," 1 ♀; "debris in pseudo fork of swamp white oak," 1 ♀; "bush fork accumulation," 3 ♀ ♀; Aug. 21, 1965, "bush fork accumulation," 1 ♀. CALHOUN COUNTY, 1 mile N.W. of Blountstown, July 25, 1965, W.S. leg., multiple sawdust piles about 15 years old near swamp forest, "sawdust and litter from periphery under magnolia shrubs," 12 ♀ ♀; "outwash leaf-litter at edge of sawdust pile," 17 ♀ ♀; Scott's Ferry, "floor-litter under oak and magnolia shrubs in pine woods," 3 ♀ ♀. COLLIER COUNTY, East of Ochopee, cypress-palmetto-maple swamp, June 17, 1965, W.S. leg., "debris in Cypress buttress," 1 ♀; Collier-Seminole State Park, Royal Palm Hammock, Aug. 28, 1965, W.S. leg., "litter under ferns and bushes," 2 ♀; same, H.R.S. leg., "debris under banana trees," 1 ♀; Monroe Station, 3 miles east, cypress swamp, Aug. 28, 1965, W.S. leg., 72 ♀ ♀; same, H.R.S. leg., "hammock-like swamp grass litter," 8 ♀ ♀. DADE COUNTY, Florida City, pine-palmetto woods, Aug. 26, 1965, W.S. leg., "debris at pine buttress," 109 ♀ ♀; "debris under banana tree," 74 ♀ ♀; same, no microhabitat data, 74 ♀ ♀; Everglades National Park, Palma Vista Hammock, Nov. 26, 1961, J. Wagner² leg., "floor duff," 26 ♀ ♀; June 18, 1965, W.S. leg., "floor pocket," 25 ♀ ♀; "debris at buttress of gumbo-limbo," 6 ♀ ♀; "litter at logs with polypore fungi," 46 ♀ ♀; "stage 3 branch," 9 ♀ ♀; "floor litter," 95 ♀ ♀; "litter in small limestone sink," 43 ♀ ♀; "floor litter at log," 376 ♀ ♀; same, no microhabitat data, 180 ♀ ♀; H.R.S. Jr. leg., "forest floor debris at fallen logs," 499 ♀ ♀; "forest floor debris pockets, some with wood," 358 ♀ ♀. DIXIE COUNTY, Old Town, June 16, 1965, W.S. leg., "palmetto stump," 1 ♀. FRANKLIN COUNTY, Buck's Siding, July 21, 1965, W.S. leg., old sawdust pile near stream, "sawdust under shrubs and briars at edge of north side of old sawdust pile," 21 ♀ ♀; "litter under palmetto, sawdust pile," 2 ♀ ♀; "litter under bushes on edge of sawdust pile," 12 ♀ ♀. GULF COUNTY, 6 miles N. of Weweahitchka, July 25, 1965, W.S. leg., "sawdust and leaves under bushes at edge of sawdust pile," 60 ♀ ♀; "oak logs, stage 3," 4 ♀ ♀. HIGHLANDS COUNTY, Highlands Hammock State Park, Aug. 23-24, 1949, H. S. Dybas leg., 9 ♀ ♀; "in decaying grass pile," 1 ♀; "leaf litter," 1 ♀; June 19, 1965, W.S. leg., "palm stump," 1 ♀; Aug. 24, 1965, W.S. leg., "oak log with *Passalus*," 2 ♀;

¹ Hereafter H.R.S.=H. R. Steeves, Jr.

² Hereafter J.W.=J. Wagner.

"debris at buttress of cypress and oak," 1 ♀; "floor litter from drainage depression," 2 ♀ ♀; "pine-magnolia pseudo fork debris," 4 ♀ ♀; H.R.S. leg., "debris inside palm logs," 4 ♀ ♀; "debris in pine-magnolia buttress," 5 ♀ ♀; "forest floor debris," 3 ♀ ♀; "cypress swamp debris at forest floor and at buttress," 50 ♀ ♀; Archbold Biological Station, June 12, 1955, H.S.D.¹ leg., "decayed ditch dredgings," 59 ♀ ♀; same, 20 ♀ ♀; same, 12 ♀ ♀; same, no microhabitat data, 5 ♀ ♀; "oak-pine leaves compost," 1 ♀; Nov. 15, 1959, S. W. Frost leg., "at light," 4 ♀ ♀; "Parker Islands" east of Lake Placid, Aug. 25, 1965, H.R.S. leg., "fern rhizome and woody debris, magnolia swamp," 58 ♀ ♀; "forest floor debris, pine woods on lake shore," 286 ♀ ♀; W.S. leg., "litter at log, pine grove on lake shore," 89 ♀ ♀; "debris among fern rhizomes," 86 ♀ ♀; "wet palm-palmetto pseudo fork," 188 ♀ ♀; "stage 4 log," 19 ♀ ♀; "litter under ferns at oak," 49 ♀ ♀; "stage 3 log," 1 ♀; "*Osmunda* rhizome clump," 1 ♀; "debris at magnolia buttress," 1 ♀; "floor debris at fern rhizome," 8 ♀ ♀; no microhabitat data, 15 ♀ ♀; Aug. 26, 1965, W.S., "floor debris at logs," 50 ♀ ♀; H.R.S. leg., "fern rhizome and woody debris," 97 ♀ ♀; Venus, 4 miles W., Fish Eating Creek, Aug. 25, 1965, W.S. leg., "grassy compost mixed with cypress, near water," 15 ♀ ♀; H.R.S. leg., "grass mat at edge of cypress swamp," 45 ♀ ♀; same, 20 ♀ ♀; southwest shore of Lake Istokpoga, June 14, 1955, H.S.D. leg., "debris at base of cypress on lake shore," 1 ♀; southwest shore of Lake Clay, near Lake Placid, June 14, 1955, H.S.D. leg., "leaf-litter in thicket," 2 ♀ ♀; same, 5 ♀ ♀. JEFFERSON COUNTY, 1 mile east of Capps, July 24, 1965, W.S. leg., "floor litter at log on slope to floodplain of pine-oak-sycamore forest," 1 ♀. LEE COUNTY, Fort Meyers, June 17, 1965, W.S. leg., "punk tree-buttress debris," 9 ♀ ♀. LEON COUNTY, 5 miles west of Iamonia (Tall Timbers Research Forest), August 4, 1965, W.S. leg., "debris under beech logs," 1 ♀; "damp leaf litter," 2 ♀ ♀; south of Chaires, July 19, 1965, W.S. leg., "sawdust under bush," 2 ♀ ♀; Aug. 14, 1965, W.S. leg., sawdust pile, "sawdust from bush-raspberry peripheral area of pile," 1 ♀; Aug. 29, 1965, W.S. leg., "moss on logs and in buttress in adjacent swamp," 1 ♀; same, H.R.S. leg., "sawdust pile," 4 ♀ ♀; Coe's Landing, Lake Talquin, 10 miles west of Tallahassee, Aug. 17, 1965, W.S. leg., "debris from walnut buttress near lake," 2 ♀ ♀. LEVY COUNTY, Manatee Springs State Park, Sept. 12, 1959, W.S. leg., "pine-litter," 13 ♀ ♀; Gulf Hammock, June 16, 1965, W.S. leg., "litter at moss covered logs," 23 ♀ ♀; "magnolia(?) stump," 3 ♀ ♀; "pine buttress," 1 ♀;

¹ Hereafter H.S.D.=Henry S. Dybas.

"palmetto and log litter," 12 ♀ ♀; Bronson, June 27, 1965, W.S. leg., "live-oak tree hole," 1 ♀. LIBERTY COUNTY, Sumatra, July 21, 1965, W.S. leg., "sawdust under small shrubs and raspberry on 15-year-old sawdust pile," 5 ♀ ♀. MADISON COUNTY, 5 miles east of Lee, July 31, 1965, W.S. leg., "walnut branches with *Passalus*," 10 ♀ ♀; "pine buttress," 5 ♀ ♀; 4 miles west of Madison, Aug. 21, 1965, W.S. leg., "floor litter at stage 3 pine(?) log," 3 ♀ ♀; "oak buttress," 5 ♀ ♀; Mefford's Cave, Aug. 14, 1965, S. Peck leg., "debris," 1 ♀. MARION COUNTY, 2 miles west of Silver Springs, June 27, 1965, W.S. leg., "palm log with *Fomes* fungus," 5 ♀ ♀; "sweet gum(?) log," 1 ♀; "palmetto stump," 1 ♀. MONROE COUNTY, 5 miles north of Flamingo, Everglades National Park, Aug. 27, 1965, W.S. leg., "grassy compost in shade of bush, sawgrass area," 2 ♀ ♀; "litter under shrubs along canal and Snake Bight Trail," 11 ♀ ♀. ORANGE COUNTY, Orlando, July 31, 1965, W.S. leg., "pine buttress debris, pine-palmetto area," 93 ♀ ♀; "grassy compost in field," 10 ♀ ♀; "debris in buttress of cypress," 35 ♀ ♀; "floor litter under bush, cypress area," 18 ♀ ♀; Aug. 22, 1965, W.S. leg., "debris in pine buttresses," 436 ♀ ♀; "grassy compost on edge of swamp," 178 ♀ ♀; H.R.S. leg., "pine-cypress swamp, buttress and stump debris," 382 ♀ ♀. OSCEOLA COUNTY, St. Cloud, Dec. 26, 1965, S.P.¹ leg., "debris under dead oak tree bark," 1 ♀. PINELLAS COUNTY, Tarpon Springs, June 16, 1965, W.S. leg., "cypress stump," 1 ♀. SARASOTA COUNTY, Myakka River State Park, June 16, 1965, W.S. leg., "palmetto," 3 ♀ ♀. SEMINOLE COUNTY, 3 miles north of Longwood, Aug. 23, 1965, W.S. leg., "pine-buttress," 241 ♀ ♀; "oak buttress," 480 ♀ ♀; "stage 3 linden branch with termites," 37 ♀ ♀; "debris in oak buttress," 232 ♀ ♀; "debris in oak-palmetto pseudofork," 210 ♀ ♀; "debris in oak-palm pseudofork," 564 ♀ ♀; same, H.R.S. leg., "rotten log, palmetto debris," 725 ♀ ♀; "debris, pine, palmetto buttress," 610 ♀ ♀. SUWANEE COUNTY, Falmouth, July 31, 1965, W.S. leg., "litter under oak leaves on edge of sawdust pile in oak woods," 15 ♀ ♀. TAYLOR COUNTY, Athena, Sept. 12, 1959, W.S. and J.W. leg., "pine litter," 16 ♀ ♀; Steinhatchee, 3 miles west, July 3, 1965, W.S. leg., "palm log on swamp floor," 1 ♀. VOLUSIA COUNTY, Osteen, Sept. 13, 1965, W.S. and J.W. leg., "pine litter," 3 ♀ ♀; Enterprise, Sept. 13, 1959, W.S. and J.W. leg., "pine debris," 15 ♀ ♀; 2 miles southwest of Enterprise, July 31, 1965, W.S. leg., "pine buttress, oak-pine forest," 15 ♀ ♀; "oak log and floor debris, oak-pine-palmetto woods," 1 ♀; "debris in oak buttress and fork," 2 ♀ ♀; "oak-palmetto pseudofork,

¹ Hereafter S.P.=S. Peck.

oak-pine forest," 85 ♀ ♀; "oak log, stage 3, on floor of oak-palmetto swamp," 9 ♀ ♀; "oak branch, stage 3, oak-palmetto swamp," 7 ♀ ♀; "palmetto axil debris, oak-palmetto swamp," 14 ♀ ♀; Aug. 23, 1965, "decaying crown of fallen palm," 2 ♀ ♀; "oak log, stage 3," 110 ♀ ♀; "oak tree hole," 16 ♀ ♀; "oak branch, stage 3," 13 ♀ ♀; "oak shrub pseudofork, up-land," 84 ♀ ♀; "litter under magnolia bush," 49 ♀ ♀; "palm log, lowland," 4 ♀ ♀; H.R.S. leg., "oak log," 37 ♀ ♀. WAKULLA COUNTY, 2 miles north of Sopchoppy, July 21, 1965, W.S. leg., "buttress of pine stump in pine woods," 1 ♀.

GEORGIA: BRANTLEY COUNTY, 1 mile east of Nahunta, Aug. 18, 1965, W.S. leg., "debris at pine buttress," 1 ♀. CHARLETON COUNTY, St. George, Aug. 18, 1965, W.S. leg., "litter under chicken feathers on edge of 20-year-old sawdust pile," 1 ♀; "debris at pine buttress at edge of sawdust pile," 64 ♀ ♀; "litter under raspberry at edge of sawdust pile," 6 ♀ ♀; 6 miles south of St. George, Aug. 18, 1965, W.S. leg., "debris in pseudofork of magnolia(?) -yellow poplar," 1 ♀; "debris at pine buttress with stage 3 oak log at swamp edge," 1 ♀. CLINCH COUNTY, DuPont, July 27, 1965, W.S. leg., "litter on sawdust pile under fern and pine," 12 ♀ ♀; "debris at pine buttresses in woods near sawdust pile," 2 ♀ ♀. DECATUR COUNTY, 1 mile northwest of Climax, limestone sink at "The Cave," Aug. 12, 1965, W.S. leg., "debris in pine buttress," 35 ♀ ♀. GLYNN COUNTY, 5 miles south of Thalman, Aug. 18, 1965, W.S. leg., "pine-oak pseudofork," 1 ♀; Jekyll Island, pine-oak-palmetto tangle near center of island, Aug. 18, 1965, W.S. leg., "oak buttresses," 1 ♀. GRADY COUNTY, 5 miles southwest of Beachton, Aug. 4, 1965, W.S. leg., "large wet oak log, stage 3," 1 ♀. LOWNDES COUNTY, 2 miles east of Valdosta, July 27, 1965, W.S. leg., "debris at pine buttress," 9 ♀ ♀.

ALABAMA: MOBILE COUNTY, Mobile, June 16, 1959, J.W. leg., "leaf-litter, swamp forest," 3 ♀ ♀; June 6, 1960, W.S. and J.W. leg., "pine duff, swamp," 1 ♀; Sept. 10, 1959, W.S. leg., "magnolia leaf-litter," 3 ♀ ♀; Sept. 11, 1959, W.S. leg., "maple-oak litter," 78 ♀ ♀; "pine litter, swamp forest," 22 ♀ ♀.

LOUISIANA: JEFFERSON PARISH, Harahan, Aug. 24, 1944, H.D. leg., "in decaying magnolia seed pods," 1 ♀; Sept. 26, 1944, F. Werner leg., "rotten magnolia fruit," 5 ♀ ♀. ASCENSION PARISH, Gonzales, Oct. 16, 1953, H.S.D. leg., "in wood-borer sawdust beside hollow, cut oak log," 1 ♀.

BERMUDA: HAMILTON PARISH, Hamilton Sound, Jan. 3, 1964, W. and J. H. Suter leg., "berlesed palmetto crotches," 1 ♀; same, Dec. 30, 1963, "leaf-litter, scrub forest," 1 ♀.

BAHAMA ISLANDS: South Bimini Island, June, 1951; M. Cazier and C. and P. Vaurie leg., 4 ♀ ♀; same locality, July, 1951, C. and P. Vaurie leg., 8 ♀ ♀ (1 callow).

Remarks.—*Eurygyne lutea* is most similar to *E. intricata* in general appearance, but differs conspicuously in the form of the spermatheca and, externally, in its slightly larger size, more prominent development of the eyes ventrally, and in the more acute apex of the triangular lamina of the posterior coxae.

In the series of 2,500 females examined on microscope slide mounts, there is very little variation in the spermatheca apart from variations that can be attributed to accidents of preparation or to the distorted condition of weakly sclerotized, callow individuals. All of the well-prepared specimens could be definitely assigned on the basis of spermathecal form alone without difficulty.

No males have been discovered in the large sample, which consisted of 9,164 specimens collected in 169 lots in many localities in four states and in the adjacent Bahamas and in Bermuda. The collections were made in eight separate months of the year as well. These data strongly support the hypothesis that *lutea* is a parthenogenetic species in its present recorded range. The species probably has a wider distribution in Middle America and in the West Indies, at least, but the collections of *Eurygyne* from these regions have not yet been studied in detail.

Unlike the situation in *Eurygyne intricata*, eggs were only rarely detected in the very large sample of *lutea* (about 2,500 females) mounted in Hoyer's medium on microscope slides. It is the developed chorion which shows through the abdomen and outlines the egg in such preparations. The large yolk granules can also be detected in many cases. In two females, each with a single, relatively huge egg, the eggs measured .28 by .16 mm. and .32 by .18 mm., or approximately one-half the total length of the beetle.

No reduction or polymorphism of the wings was noted in the extensive sample. In 123 females, representing 27 collections from 11 counties in Florida and 2 in Georgia, the number of marginal wing hairs in the terminal group (fig. 8) ranged from 53–61, with a mean of 57 (fig. 11). Three *lutea* females from South Bimini Island, Bahamas, had a range of from 57–59 hairs, which is well within the range of variation of the mainland sample.

***Eurygyne fusca*, new species.** Figures 4a, b; 12.

Color brown; antennae, mouthparts, legs, yellow; body covered with fine inclined yellow setae. Collar of mesothorax not extending onto humeri. Posterior

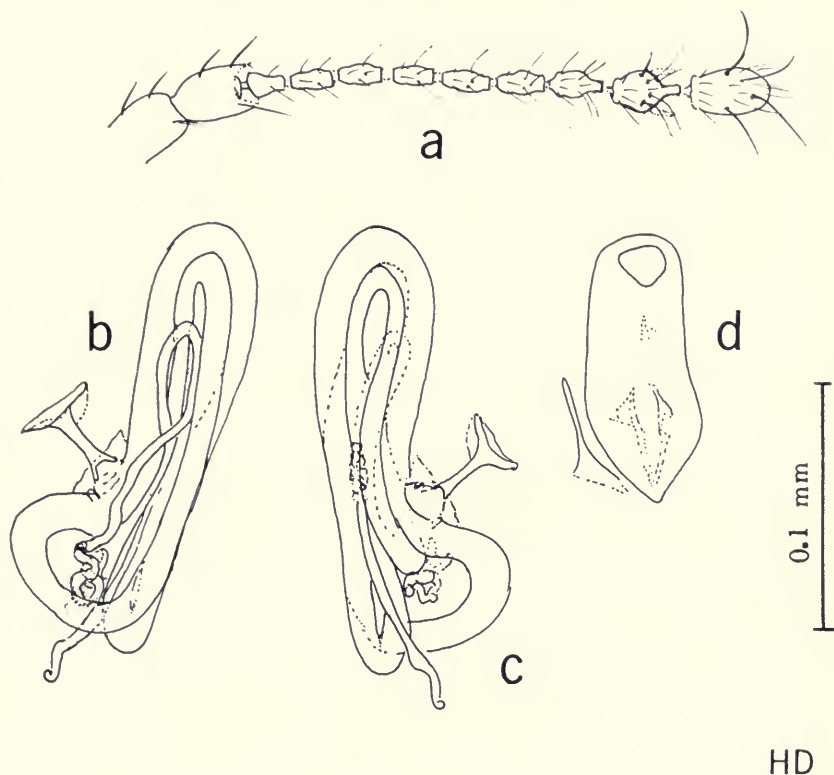


FIG. 5. *Eurygyne wagneri* n. sp., a, antenna, female. b, spermatheca, ventral view. c, spermatheca, dorsal view. d, aedeagus, ventral view.

margin of pronotum sinuately notched near posterior angles. Suture lateral to mesocoxae heavily ridged internally. Females with spermatheca of diagnostic form (fig. 4a, b). Male sex unknown.

Measurements: In dry-mounted specimens, the total length, including retracted head and apex of abdomen, is .62-.66 mm.; the width is .31-.32 mm.

Holotype.—A female, mounted on a microscope slide, from Fieldon, Jersey County, Illinois, collected Aug. 3, 1959, by W. Suter and J. Wagner, in "sawdust pile." In the collection of Field Museum of Natural History.

Paratypes.—189 ♀ ♀, same data as holotype. In the collection of Field Museum of Natural History.

Other records.—ILLINOIS: same locality as type, Nov. 3, 1965, H.S.D. leg., "in flight over large sawdust pile, 2:30 PM (CST), over-cast," 1 ♀.

ALABAMA: TALLADEGA COUNTY, McElderry, Sept. 20, 1959, W.S. leg., "berlesed sawdust pile," 5 ♀ ♀; MARSHALL COUNTY, Guntersville, June 22, 1959, W.S. and J.W. leg., "berlesed sawdust pile," 1 ♀; BIBB COUNTY, Brent, Sept. 9, 1959, W.S. leg., "sawdust pile," 35 ♀ ♀.

FLORIDA: LEON COUNTY, Tallahassee, Sept. 15, 1944, J. H. Davis leg., "berlesed oak-pine leaves compost," 6 ♀ ♀ + 7 fragm. ♀ ♀, 27 unsexed; HIGHLANDS COUNTY, Archbold Biological Station near Lake Placid, Nov. 15, 1959, S. W. Frost leg., "at light," 1 ♀. JEFFERSON COUNTY, Monticello (6 miles W.), July 24, 1965, W.S. leg., "beech tree-hole," 1 ♀; same, "sawdust pile—sawdust under logs," 195 ♀ ♀; same "litter pocket at logs on sawdust pile," 92 ♀ ♀.

MISSISSIPPI: JACKSON COUNTY, 4 miles east of Ocean Springs, Oct. 15, 1953, H.S.D. leg., "sifting floor litter in mixed pine-deciduous forest," 4 ♀ ♀.

MARYLAND: HOWARD COUNTY, Woodstock, July 26, 1959, W.S. and J.W. leg., "sawdust," 1 ♀; GARRETT COUNTY, 3 miles west of Deer Park, July 25, 1959, W.S. leg., "sawdust," 2 ♀ ♀.

PENNSYLVANIA: WESTMORELAND COUNTY, Seward, July 28, 1959, W.S. leg., "sawdust," 25 ♀ ♀; south of Seward, July 24, 1959, J.W. leg., "sawdust pile," 3 ♀ ♀.

TENNESSEE: MCNAIRY COUNTY, Selmer, Sept. 9, 1959, W.S. leg., "sawdust," 66 ♀ ♀.

WEST VIRGINIA: TUCKER COUNTY, north of Dryfork (near Harmon), Sept. 4, 1964, J.W. leg., "under boards in old sawdust, and berlese of same," 7 ♀ ♀.

Remarks.—This species is easily distinguished by the form of the spermatheca (fig. 4a, b) which shows remarkably little variation in the approximately 630 females examined. All of the specimens seen could be easily assigned by this one character alone. There are also color and facies differences which cannot be described or figured well. There are no males whatever in this sample of 630 specimens, which consists of 18 collections from eight states. The specimens were collected in five different months of the year. These data, like those for *E. lutea* and *E. frosti*, suggest that *fusca* is a parthenogenetic species, at least in the region from which it is recorded in the present study.

Several females each had a single large egg in the abdomen. Four eggs measured .28 by .16 mm., .26 by .15 mm., .26 by .17 mm., and .26 by .15 mm. The measured eggs all had the chorion well developed.

The distribution of this species in the United States differs from the pattern of the other species of *Eurygyne*. It is distributed widely in the eastern United States but it has been found outside of the immediate vicinity of the Gulf of Mexico only in sawdust piles left from sawmill activities. This pattern of distribution will be analyzed in more detail in the *Discussion* section of this paper.

***Eurygyne frosti*, new species. Figures 4f; 13.**

Color brown; antennae, mouthparts, legs and abdomen yellowish; body covered with fine inclined yellow setae. Collar of mesothorax not extending onto humeri. Posterior margin of pronotum sinuately notched near posterior angles. Suture lateral to mesocoxae heavily ridged internally. Females with spermatheca of diagnostic form (fig. 4f). Male sex unknown.

Measurements: In slide-mounted specimens, the length from the anterior margin of the pronotum to the apex of the elytra, is about .53 mm. In dry-mounted specimens, the total length, including the retracted head and apex of abdomen, is .56-.58 mm.; the width is .30-.32 mm.

Holotype.—A female, mounted on a microscope slide, from the Archbold Biological Station, near Lake Placid, Highlands County, Florida, collected Nov. 15, 1959, by S. W. Frost, "at light." In the collection of Field Museum of Natural History.

Paratypes.—150 ♀ ♀, same data as holotype. In the collection of Field Museum of Natural History and in the S. W. Frost Collection. Numerous broken specimens not included in the type series.

Other records.—FLORIDA: BAY COUNTY, Panama City, July 10, 1965, W.S. leg., "grassy compost," 1 ♀. COLLIER COUNTY, Collier-Seminole State Park, Royal Palm Hammock, Aug. 28, 1965, W.S. leg., "litter under fern and bushes," 1 ♀; same, H.R.S. leg., "debris under banana trees," 1 ♀; 3 miles east of Monroe Station, Aug. 28, 1965, W.S. leg., "roadside grassy litter at edge of cypress swamp," 15 ♀ ♀. DADE COUNTY, Everglades National Park, Palma Vista Hammock, Aug. 27, 1965, W.S. leg., "debris at buttress of large smooth-barked tree," 1 ♀; same, H.R.S. leg., "forest floor debris, with some wood," 1 ♀. HIGHLANDS COUNTY, Archbold Biological Station, near Lake Placid, June 12, 1955, H.S.D. leg., "oak-pine leaves compost," 4 ♀ ♀; same, no microhabitat data, 1 ♀; Highlands Hammock State Park, Aug. 24, 1965, H.R.S. leg., "debris from forest floor and at buttress," 1 ♀; Aug. 23-24, 1949, H.S.D. leg., "in decaying grass pile," 4 ♀ ♀; 4 miles west of Venus, Fish Eating Creek, Aug. 25, 1965, W.S. leg., "grassy compost mixed with cypress needles," 30 ♀ ♀; H.R.S. leg., "grass mat at edge of cypress swamp," 58 ♀ ♀; same, 16 ♀ ♀; "Parker Islands," Aug. 25, 1965, W.S. leg.,

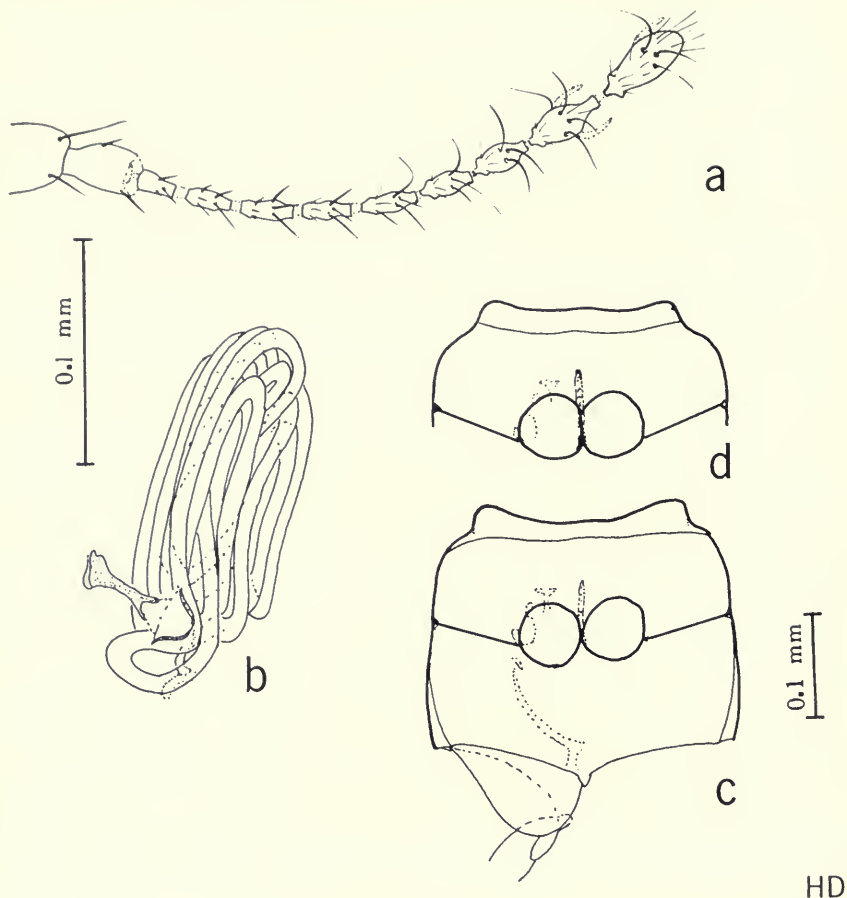


FIG. 6. *Eurygyne contorta* n. sp., a, antenna. b, spermatheca, ventral view. c, underside of meso- and metathorax showing collar extending onto humeri. d, same, of *E. intricata*, collar not extending onto humeri.

"litter under ferns at oak," 1 ♀; H.R.S. leg., "fern rhizome and woody debris, magnolia swamp," 1 ♀; same, but Aug. 26, 1965, 1 ♀. LEON COUNTY, south of Chaires, Aug. 29, 1965, H.R.S. leg., "sawdust pile," 1 ♀. MONROE COUNTY, 5 miles north of Flamingo, Everglades National Park, Snake Bight Trail, Aug. 27, 1965, W.S. leg., "grassy compost in sawgrass area," 6 ♀ ♀; 5 miles south of North Key Largo, Aug. 27, 1965, W.S. leg., "floor debris at log," 1 ♀. ORANGE COUNTY, Orlando, Aug. 22, 1965, W.S. leg., "grassy compost at edge of swamp," 1 ♀; "grassy compost in field," 3 ♀ ♀.

BAHAMA ISLANDS: SOUTH BIMINI ISLAND, August, 1951, C. and P. Vaurie leg., 1 ♀ (AMNH).

Remarks.—This species is dark in color, like *E. fusca*, but it is easily separated by the form of the spermatheca, which is diagnostic. Approximately 370 females (including fragmentary individuals) have been studied on permanent or temporary slide preparations. The spermatheca, though more variable than in *lutea* and *fusca*, is diagnostic and no variations were seen that created problems of identification. Eight females each had a single egg which averaged .32 by .17 mm. In 13 specimens, the apical group of wing hairs ranged from 53 to 63 and averaged 57, the same as in *lutea*.

The 23 collections are from seven counties in Florida and from the Bahama Islands and span a period of six months of the year, yet all of the approximately 370 specimens collected are females. Again, as in *E. lutea* and *E. fusca*, the evidence points to complete parthenogenesis in these populations.

The mouth-parts of the type series appear seemingly aberrant; the palpiger of the labial palpi appears different from that of the other collections of *frosti*, and the lacinia and galea seem to be absent in the type specimens. In addition, the stipes is angled mesad. I have interpreted these differences as artifacts of preservation and preparation. The type lot was collected "at light" and had been dried (and perhaps subjected to other treatment as well) before being returned to alcohol. Whatever the treatment, the natural elasticity of the exoskeleton was not restored when the specimens were processed for microscope slide mounts. In these seemingly aberrant mouth-parts, the galea is hinged inward (dorsad) into the head capsule, and is not visible, the lacinia is similarly out of view in most specimens, and the labial palps are directed dorsad from the hinge line at the anterior margin of the mentum, thereby showing a different angle of the palpigers and an apparently different form. When two specimens of *frosti* still in alcohol were dissected, the "missing" galea and lacinia were found tucked behind the mentum and labial palpi, the galea being folded on itself as well.

The largest collection was made "at light" at the Archbold Biological Station. This raises a problem of interpretation since Ptiliidae, as stated earlier in this paper, have not been regarded as possessing well-developed powers of directional flight. When only a few specimens are encountered on a light sheet or in a light trap, one can assume that Ptiliidae that are dispersing passively have been intercepted by the light sheet or trap. The type lot of *frosti*, however,

consists of more than 200 specimens taken "at light" in a single night. Frost (1963) states that the Ptiliidae (=Trichopterygidae) came to the lights at the Archbold Biological Station early when the light traps were operated between 5:30 and 6:00 PM on Nov. 10-16, 1960. "No counts were made of the Trichopterygidae, but observations revealed that they came decidedly before 6 PM, usually within a few minutes and sometimes in enormous numbers, striking against the baffles of the trap like buckshot." If these actually represented an intercepted sample of passively floating Ptiliidae, there must have been astonishing numbers floating in the air. The "at light" sample submitted by Dr. Frost contained four species of *Eurygyne*, of which *frosti* accounted for most of the collection.

***Eurygyne suteri*, new species. Figures 7a, b; 13.**

Color light brown, antennae and mouth parts yellow; body covered with fine recumbent yellow setae. Collar of mesothorax not extending onto humeri. Suture lateral to the mesocoxae marked for its full length by a heavy internal skeletal ridge. Females with spermatheca of diagnostic form (fig. 7a, b). Male sex unknown.

Measurements: In slide-mounted specimens, the length from the anterior margin of the pronotum to the apex of the elytra is about .54 mm.; the width is about .32 mm.

Holotype.—A female, mounted on a microscope slide, from Palma Vista Hammock, Everglades National Park, Dade County, Florida, collected August 27, 1965, by Walter Suter, from berlese sample of floor litter in buttress of large smooth-barked tree. In the collection of Field Museum of Natural History.

Paratypes.—Same data as holotype, 5 ♀ ♀ (1 callow); "litter in small, limestone sink," 3 ♀ ♀; "floor litter on slope from road into swamp," 5 ♀ ♀; no microhabitat data, 8 ♀ ♀ (1 callow); same data but H. R. Steeves, Jr. leg., "pockets of forest floor debris, some with wood," 1 ♀; "forest floor debris at fallen logs," 2 ♀ ♀. COLLIER COUNTY, 3 miles east of Monroe Station, Aug. 28, 1965, H. R. Steeves, Jr. leg., "hammock-like swamp grass litter," 1 ♀; same data except "roadside grassy litter at edge of swamp," 5 ♀ ♀. DADE COUNTY, Florida City, Aug. 26, 1965, W. Suter leg., "no microhabitat data," 1 ♀. HIGHLANDS COUNTY, 4.5 miles west of Venus, at Fish Eating Creek, Aug. 25, 1965, H. R. Steeves, Jr. leg., "grass mat at edge of cypress swamp," 7 ♀ ♀; same locality, W. Suter leg., "grassy compost mixed with cypress needles near water," 2 ♀ ♀. ORANGE COUNTY, Orlando, Aug. 22, 1965, "grassy compost at edge of swamp," 1 ♀; "litter at pine buttress," W. Suter leg., 1 ♀ (callow).

Remarks.—This species is similar to *E. frosti*, but is lighter in color. It is easily separated from all the other species by the diagnostic form of the spermatheca. The 46 specimens examined, from 15 collections, were all females; no males have been found. The sample

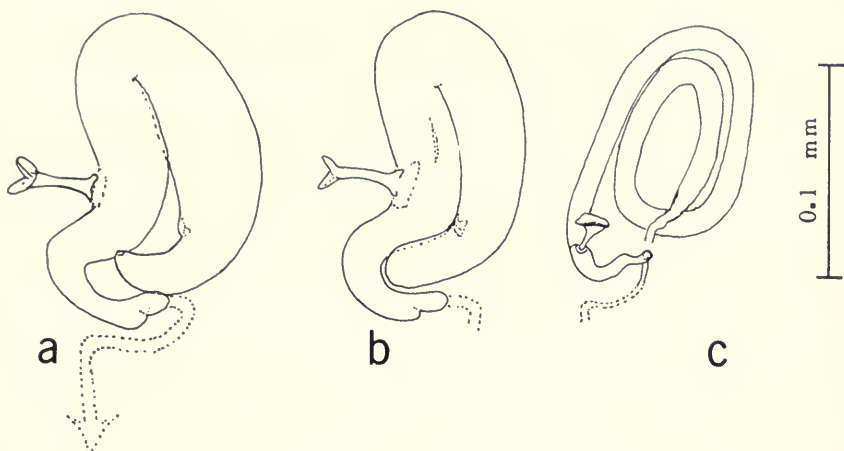


FIG. 7. *a*, *Eurygyne suteri* n. sp., spermatheca, ventral view. *b*, same, another individual, showing variation. *c*, *Eurygyne steevesi* n. sp., spermatheca, ventral view.

is not large but, in view of the pattern of parthenogenesis within the genus, it is likely that *E. suteri* is also a completely parthenogenetic species, at least in the range here recorded. One female had a single, relatively huge egg in the abdomen that measured .32 by .20 mm., or half the length of the animal. In 20 females, the apical group of wing hairs ranged from 57 to 64 with a mean of 61.

Eurygyne suteri Dybas was invariably collected in the field with the far more abundant *lutea*. The 15 berlese samples in which the 46 specimens of *suteri* were found also contained 2,815 female specimens of *lutea*, 190 female *frosti* (8 lots), 114 female *contorta* (4 lots), 15 specimens of *wagneri* (2 lots), and one female of *steevesi*. Thus, it is an extremely minor component of the *Eurygyne* fauna of the United States, at least in the microhabitats sampled so far.

Eurygyne steevesi, new species. Figures 7c; 13.

Color brown, collar of mesothorax not extending onto mesopleural humeri. The suture lateral to the mesocoxae, not marked with a heavy internal skeletal ridge except near coxa. Female spermatheca of diagnostic form, as shown in Figure 7c. Male sex unknown.

Measurements: In slide-mounted specimens, the length from the anterior margin of the pronotum to the apex of the elytra is .51 mm.; the width of the pronotum is .32 mm.

Holotype.—A female, mounted on a microscope slide, from Florida City, Dade County, Florida, collected Aug. 26, 1965, by Walter Suter, in debris under banana. In the collection of Field Museum of Natural History.

Paratypes.—Same data as type, 1 ♀; DADE COUNTY, Everglades National Park, Palma Vista Hammock, Aug. 27, 1965, H. R. Steeves, Jr. leg., "forest floor debris at fallen logs," 1 ♀.

Other record.—HIGHLANDS COUNTY, Archbold Biological Station, near Lake Placid, Nov. 15, 1959, S. W. Frost leg., "at light" (specimen later lost), 1 ♀.

Remarks.—This species is easily distinguished by the diagnostic form of the spermatheca. It also differs from all the species described in this paper in the condition of the suture lateral to the mesocoxae, which is marked internally by a heavy endoskeletal ridge only near the coxa; laterally it is a fine surface suture. Since only four females have been seen, it is not possible to say at present whether the species is parthenogenetic or not. In one specimen, the number of wing hairs in the apical group is 56 in one wing and 53 in the other.

Eurygyne wagneri, new species. Figures 5a-d; 13.

Color yellow-brown. Collar of mesothorax extending onto mesopleural humeri (fig. 6c). Middle antennal segments short, as in figure 5a. The suture lateral to the mesocoxae marked internally by a heavy endoskeletal ridge. Spermatheca of female as in figure 5b, c. Male aedeagus as in figure 5d. Male with a median fovea on front of head.

Measurements: Length from anterior margin of pronotum to apex of elytra: in males, .45-.50 mm.; in females, .48-.51 mm.; width of pronotum: .27-.29 mm.

Holotype.—A female, mounted on a microscope slide, from Florida City, Dade County, Florida, collected Aug. 26, 1965, by Walter Suter, "debris under banana," in pine-palmetto woods. In the collection of Field Museum of Natural History.

Allotype.—A male, mounted on a microscope slide, same data as the holotype. In the collection of Field Museum of Natural History.

Paratypes.—Same data as the holotype, 24 ♀ ♀, 16 ♂ ♂; same, but no microhabitat data, 4 ♀ ♀, 10 ♂ ♂. Everglades National Park, Palma Vista Hammock, Nov. 26, 1961, J. Wagner leg., "floor duff," 2 ♀ ♀, 1 ♂; same locality, Aug. 27, 1965, W. Suter leg., no microhabitat data, 1 ♀.

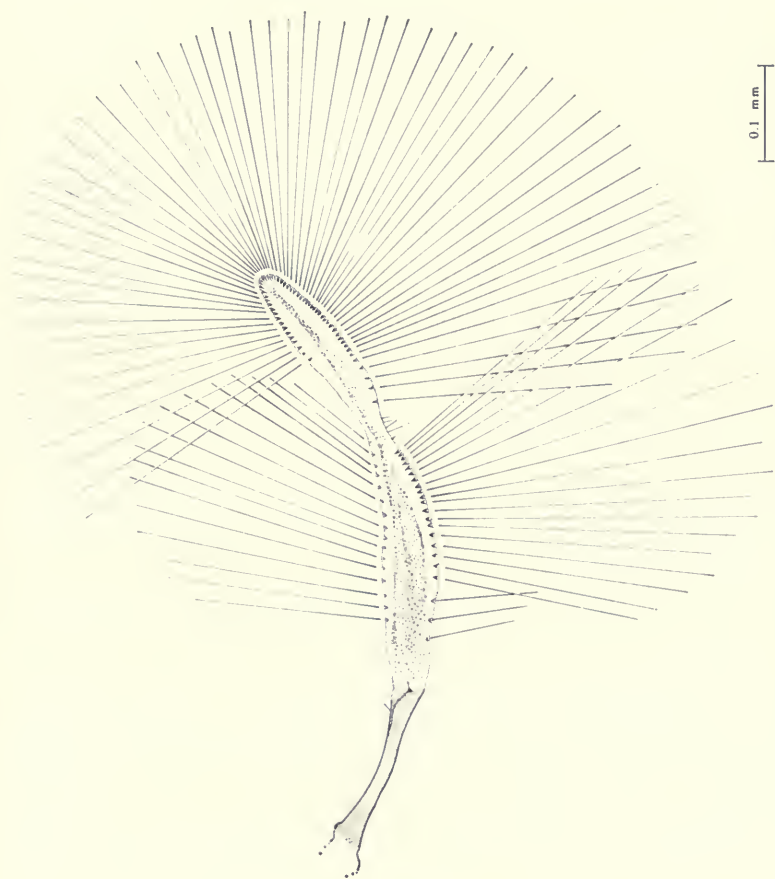


FIG. 8. *Eurygyne lutea* n. sp., metathoracic wing (description in text).

Remarks.—This species is related to *Eurygyne contorta* in the form of the mesothoracic collar, the delimiting line of which extends onto the mesopleural humeri, as in Figure 6c. The females differ from *contorta* by the pale color, and from it and all the other species described in this paper by the shorter antennal segments (fig. 5a), and the shape of the spermatheca. The males can be separated from the only other males known so far, those of *intricata*, by the condition of the mesothoracic collar, the short antennal segments, and the presence of a fovea on the frons.

One of the females had a single large egg in the abdomen that measured .33 by .22 mm. In 43 specimens (21 ♂♂, 22 ♀♀), the wing hairs in the apical group ranged from 36–49, with a mean of 44. There was no significant variation between the sexes in the wing hairs.

Eurygyne wagneri is the only species on the mainland of the United States in which the male sex is known. The sex ratio in the 60 specimens known is 33 ♀♀ : 27 ♂♂.

***Eurygyne contorta*, new species. Figures 6a–c; 13.**

Color brown, shining; antennae, legs, and underside of abdomen lighter; sparsely covered with light-colored, inclined hairs. Body elongate-oval and somewhat flattened in form. Collar of mesothorax, extending onto mesopleural humeri (fig. 6c). Suture lateral to mesocoxae marked internally by a heavy endoskeletal ridge. Antennae as in Figure 6a. Spermatheca (fig. 6b) more convoluted than in the related *wagneri*. Male sex unknown.

Measurements: Length of slide-mounted specimens from anterior margin to apex of the elytra, .51 mm.; width, .28 mm.

Holotype.—A female on a microscope slide, from Fish Eating Creek, 4 miles west of Venus, Highlands County, Florida, collected Aug. 25, 1965, by Walter Suter, "cypress swamp, in grassy compost mixed with cypress needles near water." In the collection of Field Museum of Natural History.

Paratypes.—Same data as holotype, 21 ♀♀; same, H. R. Steeves, Jr. leg., "cypress swamp, grass mat at edge," 99 ♀♀.

Other records.—FLORIDA: COLLIER COUNTY, east of Ochopee, June 17, 1965, W.S. leg., "cypress buttress in cypress-palmetto-maple swamp along U. S. highway No. 41," 1 ♀. DADE COUNTY, Everglades National Park, Palma Vista Hammock, Aug. 27, 1965, H.R.S. leg., "forest floor debris at fallen logs," 1 ♀. HIGHLANDS COUNTY, Archbold Biological Station, near Lake Placid, Nov. 15, 1959, S. W. Frost leg., "at light," 1 ♀; same, June 19, 1965, W.S. leg., "pine buttress in pine-palmetto stand," 2 ♀♀; "Parker Islands," Aug. 25, 1965,

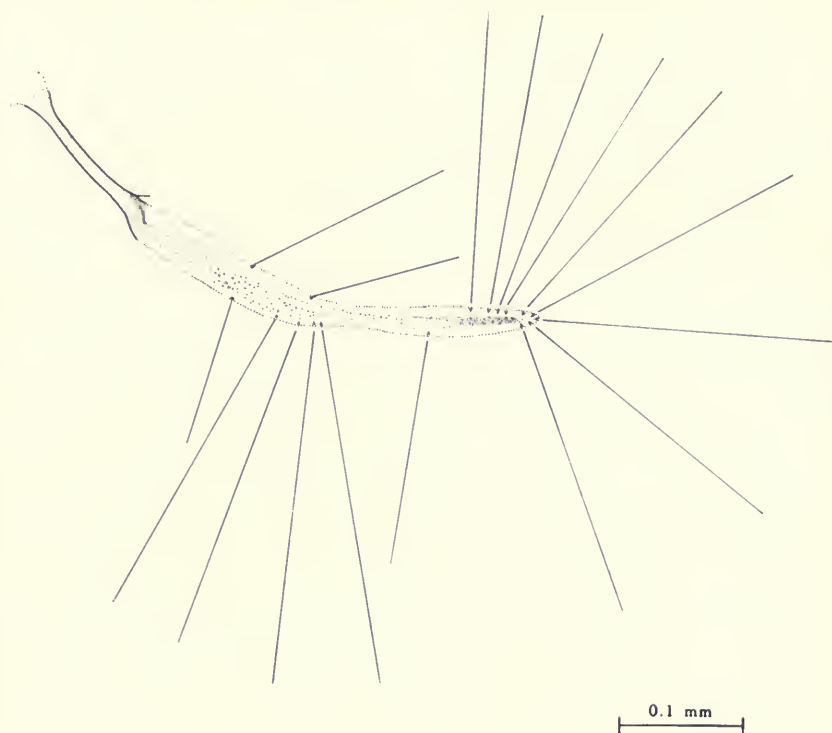


FIG. 9. *Eurygyne intricata* n. sp., metathoracic wing, showing a reduced stage of marginal hairs in a polymorphic population.

W.S. leg., pine-oak grove, "litter under ferns," 1 ♀; "litter at log," 1 ♀; H.R.S. leg., "forest floor debris," 1 ♀; Highlands Hammock State Park, Aug. 24, 1965, H.R.S. leg., "forest floor debris, and at buttress," 9 ♀ ♀. SEMINOLE COUNTY, 2 miles north of Longwood, Aug. 23, 1965, H.R.S. leg., pine-oak-palmetto forest, "debris from palmetto under rotten log," 1 ♀; 3 miles north of Longwood, W.S. leg., "oak-palmetto pseudofork," 2 ♀ ♀; VOLUSIA COUNTY, 2 miles southwest of Enterprise, Aug. 23, 1965, H.R.S. leg., "oak log," 1 ♀.

Remarks.—This species is more elongate and more flattened in form than the members of the *intricata* group. It is most closely related to *wagneri* in the condition of the collar of the mesothorax, but differs in the form of the spermatheca and the proportions of the antennal segments. Four females each had a single egg that averaged .32 by .20 mm. In 22 females, the apical group of marginal wing hairs ranged from 56–62, with a mean of 60.

All of the 142 specimens are females; no males are known. Since these represent 13 collections made over a span of six months in five counties in Florida, it is very probable that *contorta*, too, is a completely parthenogenetic species, like most of the *Eurygyne* species described in this paper.

DISCUSSION

Though no species of *Eurygyne* have been previously recorded from the United States, the genus is clearly a dominant group of featherwing beetles in the floor stratum of Florida. To illustrate this, I have tabulated comparable collections made in the summer of 1965 in 30 counties that span the whole state of Florida. The collections were all made by the same person, Dr. Walter Suter of Carthage College, and total 12,151 Ptiliidae representing at least ten genera. Parenthetically, this is probably the finest sample of Ptiliidae of the floor stratum of a geographic area ever made. Of this total, the specimens of *Eurygyne* number 5,723, or 47%.

If, on the other hand, the percentages are calculated separately for northern versus peninsular Florida, a significant difference appears. I have selected a more or less arbitrary dividing line roughly at the point of greatest constriction near the base of the peninsula (fig. 14). For convenience, the three counties (Levy, Marion, and Volusia) dissected by this line are assigned to peninsular Florida. South of this line, in peninsular Florida, there are 8,075 Ptiliidae from 13 counties in the sample. The *Eurygyne* number 4,975 specimens, or 62%. North of this line there are collections from 17 Florida counties, totalling 4,076 Ptiliidae, of which 748, or 18%, are *Eurygyne*. Thus, there is a striking drop in the proportion of *Eurygyne* as one leaves peninsular Florida. The same pattern appears in the number of species of *Eurygyne*—all seven known U. S. species occur in peninsular Florida, but only three of these have been collected outside this area in the United States. These facts merely reflect, I believe, the essentially tropical distribution of the genus *Eurygyne*.

Parthenogenesis has not been reported before in the Ptiliidae, but the evidence presented in this paper strongly supports its occurrence in five species of *Eurygyne*. These species are *frosti*, *lutea*, *fusca*, *contorta*, and *suteri*, of which I have examined 370, 2,500, 630, 142, and 46 females, respectively, without seeing a single male. Males are known for only two of the eight species described in this paper. One of these is *wagneri* from Florida, which has a roughly even sex ratio

in the 60 specimens known; the other is *intricata* from South Bimini Island off the coast of Florida, which has a sex ratio of 43% males and 57% females in the 581 specimens that were sexed. The last new species, *stevesi*, is only known from three collections totalling four females, so judgment must be suspended as to its condition. Thus, of the eight new species described in this paper, two are definitely bisexual, five appear to be parthenogenetic, and the condition of one is uncertain.

Not all the evidence, though, is consistent with the hypothesis of complete parthenogenesis in *Eurygyne*. A spermatheca is a nonfunctional structure in a completely parthenogenetic species. Such nonfunctional structures ought to become vestigial in time, or, at least, ought to become more variable because of less stringent selection. Yet all the presumptively parthenogenetic species retain the spermatheca in apparently functional form and, moreover, exhibit little variability in this structure.

Alternative hypotheses to that of complete parthenogenesis, are that males are produced only at certain times of the year, or that they have unusual habits which would prevent their being collected with the females, but such sexual differences are unknown in any Ptiliidae. Another possibility is that we may be sampling peripheral parthenogenetic populations of species which have males in one part of the range and not in another, in which case the species as a whole is not completely parthenogenetic. Suomalainen (1962), in a recent review of parthenogenesis in insects, cites several cases in which a given species is bisexual in one area and parthenogenetic in another. The weevil genus *Otiorrhynchus*, for example, has at least ten species of this kind in Europe. In most of these, the bisexual races occur outside the areas covered by ice during the Würm glaciation, while the parthenogenetic races have, for the most part, spread into the areas later freed from ice. Suomalainen suggests possible reasons for these different distributions in the parthenogenetic and bisexual races in *Otiorrhynchus*. A somewhat similar case has been presented by Reichle (in press) on a species of beetle of the family Pselaphidae (*Bythinopsis tychoides* Brendel) that is found in bogs in northeastern United States. There is a roughly equal sex ratio in New York and New Jersey; whereas west of the Allegheny Mountains, only females have been collected.

The range of *Eurygyne*, on the basis of unpublished data as well as on the localities recorded in this paper, is primarily tropical. Its northern extension into the United States may well be a peripheral

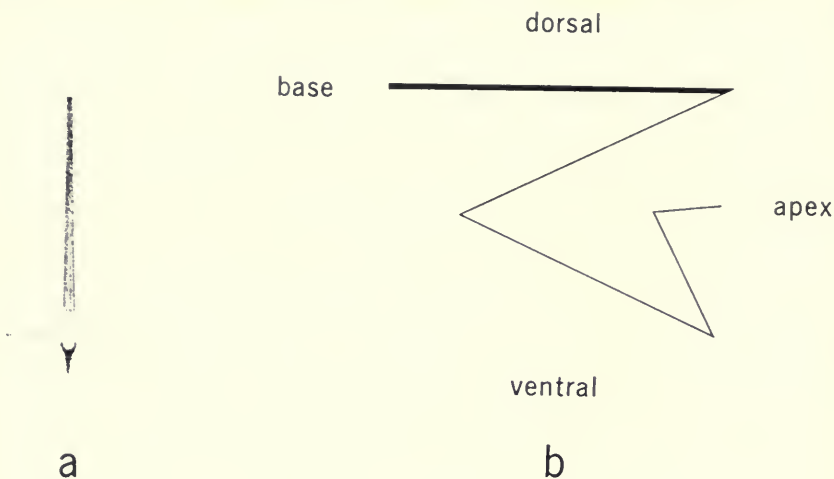


FIG. 10. *Eurygyne lutea* n. sp., a, portion of a marginal wing hair, showing transparent, flexible basal portion, and insertion in socket in wing membrane. b, diagram of wing-folding pattern. In the terminology of Forbes (1926) the transverse folds are convex—concave—concave—convex.

one, and the main ranges of the species treated here may be in the West Indies or in Middle and South America where the genus has not yet been studied. When the more tropical components of *Eurygyne* are studied, the pattern of parthenogenesis may appear to be different.

Returning to the problem of the 'non-functional' spermatheca, a simple explanation for its uniformity, in view of relaxed selection, suggests itself. The two main sources of genotypic variation in bisexual species are gene flow and recombination (see Mayr, 1963, for a recent review). In a completely parthenogenetic species, gene flow is precluded and recombination of genes is no longer possible, at least between different individuals. Segregation within an individual may be possible depending on whether the parthenogenesis is of the meiotic or ameiotic type (White, 1954). In any case, mutation is left as a main immediate source of genotypic variability in a completely parthenogenetic form. In such a species, the accumulation of viable mutations in the loci affecting the form and structure of the spermatheca may be so slow as to have little effect on its variability over long periods of time. This alone may account for the retention of an apparently functional spermatheca, and its low variability in the presumptively parthenogenetic species of *Eurygyne*.

Nothing is known, of course, of the cytogenetics of *Eurygyne*, but in the *Otiorrhynchus* weevils, all of the parthenogenetic species stud-

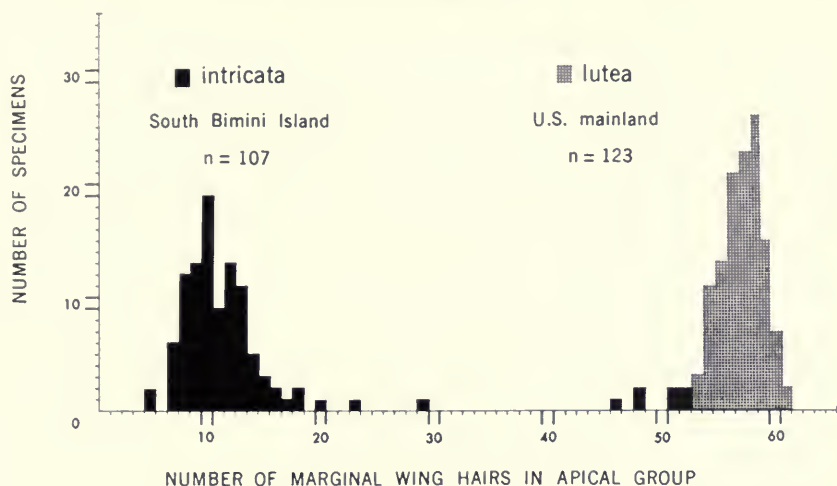


FIG. 11. Graph of number of marginal wing hairs in apical group in *Eurygyna intricata* n. sp. and *lutea* n. sp.

ied to date are polyploid. In those cases, as stated by Suomalainen (1962), "the newly arisen mutations have difficulty expressing themselves, as they are counterbalanced by several doses of the original allele."

Because recombination of genes between different individuals is no longer possible in parthenogenetic forms, their genetic systems are presumably at a disadvantage in the long run because of the lack of adaptability to changing circumstances. In the short run, though, a completely parthenogenetic species may be quite successful. Most of the parthenogenetic *Otiorrhynchus* weevils have larger ranges than their bisexual relatives (Suomalainen, 1962), though here the factor of polyploidy is also involved.

The advantages of parthenogenesis (White, 1954, and Suomalainen, 1962) include these: 1) parthenogenesis permits the fixation of genotypes particularly favorable for special situations; 2) it facilitates expansion into new areas because any individual at any stage of development can establish a population in a favorable place; 3) it increases fecundity by a factor of two because all of the eggs can produce females—none are 'wasted' (Mayr, 1963) on males. There are also some other possible genetic advantages (Dobzhansky, 1951).

All of these advantages may apply to the parthenogenetic species of *Eurygyna*; but the third point, the increase in fecundity, seems particularly relevant. Earlier, it was shown that only one relatively huge

egg is matured in the abdomen at one time. This is true of the two bisexual species, *E. intricata* and *wagneri*, as well as of five parthenogenetic species, *E. lutea*, *fusca*, *frosti*, *contorta*, and *suteri*, so it very probably holds throughout the entire genus. These mature eggs are approximately one-half the total length of the entire body! In some other unrelated genera in the Ptiliidae (e.g., five genera of U. S. Pterycini, unpublished data), there is similarly only one large mature egg at a time, indicating that this habit may be widespread in the family. The Ptiliidae have active staphyliniform larvae (Hinton, 1941, and unpublished data) and their eggs must be provided with enough yolk for embryogenesis to continue until the highly organized larva is fully formed and self-sufficient. Presumably, this explains why there must be such a relatively large egg in such a small insect. Rensch (1948) has pointed out that one of the consequences of evolution toward small size in arthropods is a reduction in the number of eggs that can be accommodated and matured in the abdomen, because each egg must be furnished with sufficient yolk to complete embryogenesis; in the extreme case there is room for only one egg. Rensch regards egg number and egg size as important factors in setting lower limits to the evolution of small size in arthropods.

There are no data on how long a female featherwing beetle may live and reproduce nor on how long it takes a single egg to mature. It would seem, though, that a low average fecundity per female must be postulated. This is difficult to reconcile with the high densities of Ptiliidae encountered in some temporary microhabitats, and with the passive dispersal suggested by the structure of the metathoracic wings, a method of dispersal that implies considerable wastage of individuals. When more is known about these little animals, the apparent discrepancies in these statements may be reconciled. For one thing, there may have been a compensating increase in the rate of development as evolution progressed toward small size and fewer eggs. Unfortunately, there is almost no information on rates of development in the Ptiliidae. The only data in the literature (Hinton, 1941) suggest a period of development of three weeks from egg to adult in *Acrotrichis fascicularis* (Herbst) which is only remotely related to *Eurygyne*. Featherwing beetles seem to reproduce continuously rather than seasonally, judging by the presence of larvae and callow adults at different periods of the year. Thus, the 'innate capacity for increase' (Andrewartha and Birch, 1954) may well be substantially greater than the minimal egg number implies.

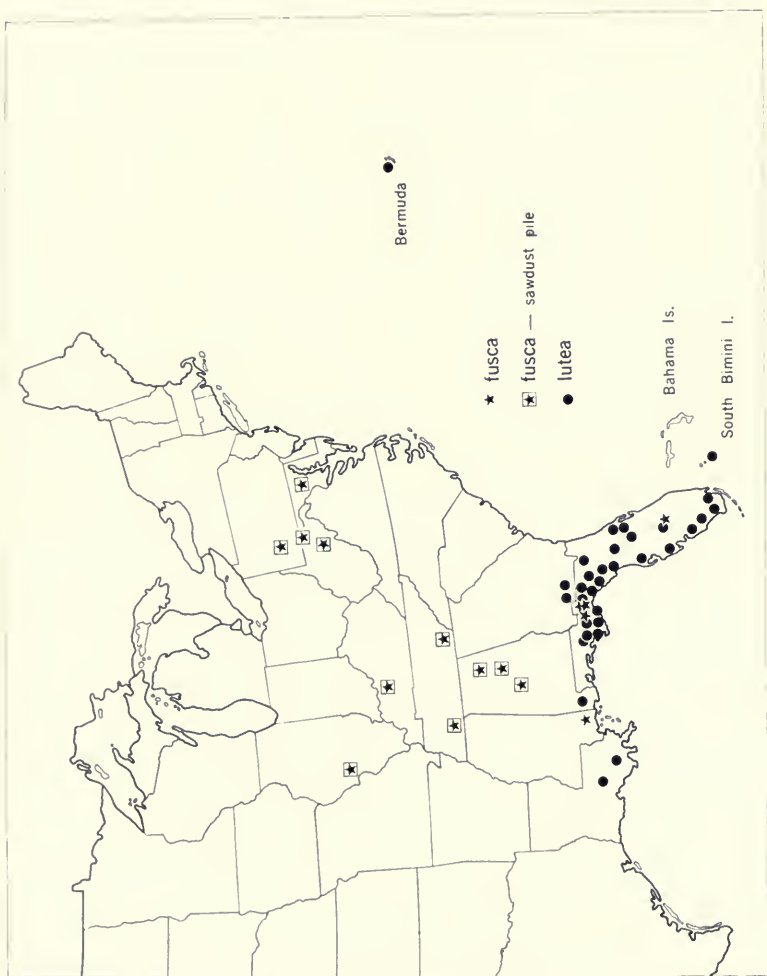


FIG. 12. Distribution map of *Eurygyna lutea* n. sp. and *fusca* n. sp. Each symbol may represent one or several collections within a county or parish.

In any case, the sudden doubling of a critically low fecundity through parthenogenesis, may confer a large selective advantage on a clone imbedded in a biparental population—a very large advantage, even when compared with the magnitudes of selective pressures now being discovered in natural populations (Ford, 1964). Though this may be of short-range evolutionary advantage, it does not preclude the temporary success of parthenogenetic populations in those insects, with appropriate genetic potentialities. If, indeed, increased fecundity is a major advantage of parthenogenesis, there should be a higher incidence of parthenogenesis in groups where evolution toward small size has greatly reduced the number of eggs produced. The Ptiliidae, on these grounds, ought to provide a test of this prediction once they are better known. As mentioned earlier, the genus *Eurygyne* will probably have many more species throughout its pantropical range when studied with appropriate techniques. In connection with general problems of parthenogenesis and evolution, there is obviously an advantage in studying a genus that has numbers of both kinds of species. Patterns with respect to geographic range, microhabitats, variation, numbers, and other population aspects may become evident when enough parthenogenetic and bisexual species within a single genus are studied and compared.

There is a further point. With one exception, the genus *Eurygyne* in the United States, according to present records, is restricted to Florida and to the southern portions of the Gulf states of Louisiana, Mississippi, and Alabama (figs. 12, 13). The northern limit is essentially defined by the winter isotherm of 50° F. The exception to this pattern is *fusca*, most of whose records are from sawdust piles left from sawmill activities north of this line; none is from a 'natural' microhabitat. South of this line, however, in addition to records from sawdust piles (Leon and Jefferson counties in northern Florida), there are small collections from "oak-pine leaves compost," "at light," and "sifting floor-litter in mixed pine-deciduous forest." These are preliminary data and much more sampling needs to be done before definitive conclusions can be drawn; nevertheless, they form a consistent pattern. The genus is clearly tropical and subtropical and, in the United States, its distribution is centered in Florida where all seven U. S. species occur. Only two species are recorded from outside the state of Florida; one of these, *lutea*, is restricted in the United States to the vicinity of the Gulf of Mexico. The evidence, then, suggests that the parthenogenetic species *fusca* is able to extend its range outside the main *Eurygyne* range into 'artificial' microhabitats provided

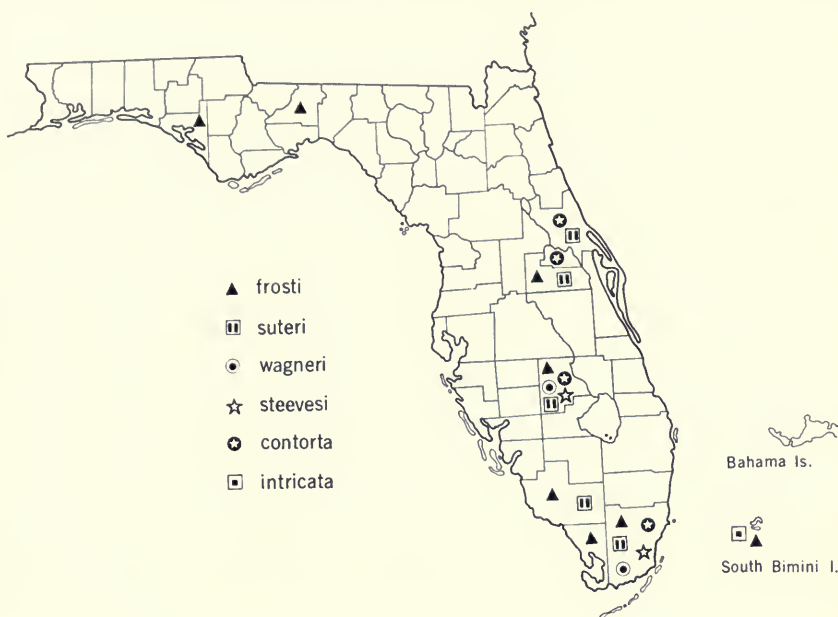


FIG. 13. Distribution map of *Eurygyne* species. Each symbol may represent one or several collections within a county or island. None of the species plotted is presently known to occur outside the area shown in the map.

by sawdust piles in the woods. Perhaps its spread into these situations is facilitated by its parthenogenesis; any individual encountering a favorable sawdust pile can establish a population.

Sawdust piles, it can be assumed, provide a warm, buffered environment that is relatively stable over long periods of time. Oxidation provides heat which is dissipated slowly through the well-insulated mass; a large pile is quite hot in the center. It may require five to ten years for a sawdust pile to acquire an appreciable micro-fauna, which may then persist for a number of years, perhaps up to twenty (Suter, personal communication). At present it is still not possible to say from which microhabitat of the forest floor, or its extensions, most of the sawdust pile fauna is derived. *Eurygyne fusca* is known from a few collections made in forest-floor litter but most of the records are from sawdust piles.

A new sawdust pile is a kind of sweepstakes situation, as suggested in conversation by my colleague Dr. Monte Lloyd. The chances of a given female finding a suitable pile are extremely small, true, but once the pile is found, the ecological opportunity for a rapidly expanding

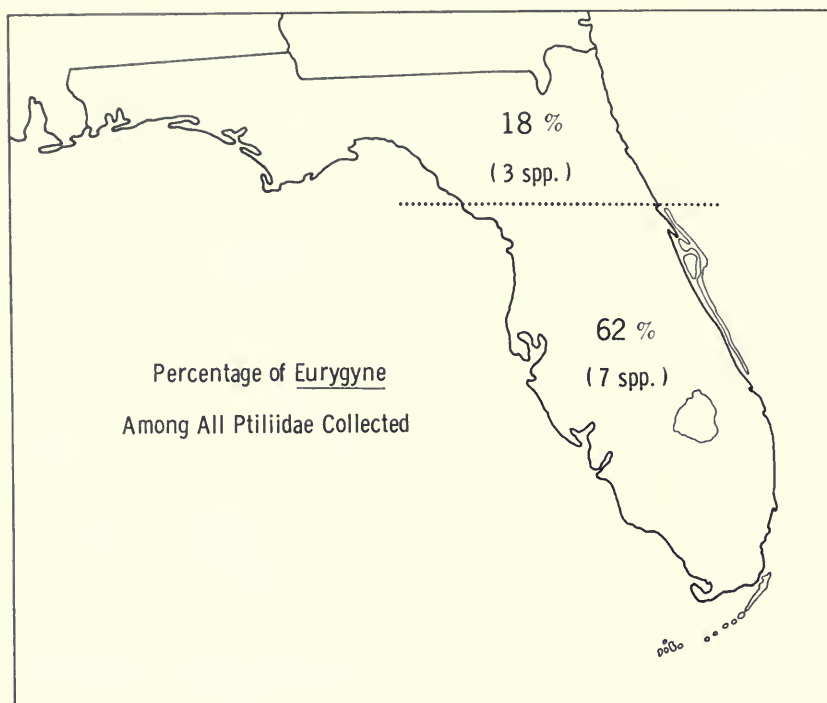


FIG. 14. Percentage of specimens of *Eurygyne* in comparable collections of Ptiliidae from the floor stratum in northern Florida, as contrasted with peninsular Florida. The collections were all made by one person (Walter Suter) in one summer (June to August, 1965). The northern collections total 4,076 Ptiliidae from 17 counties, and the peninsular collections total 8,075 Ptiliidae from 13 counties. There is a marked drop in the percentage of specimens of *Eurygyne* in the collections of Ptiliidae in northern Florida, and a similar drop in the number of species represented.

population is great, especially for a parthenogenetic species like *fusca*. Moreover, a large sawdust pile probably provides a favorable, stable environment, in one part or another, over a period of many years; the sawdust pile at the type locality near Fieldon, Illinois, still contained *fusca* after six years in 1965, and one dispersing female was collected floating in the air above the pile. Sawdust piles seem to have relatively few species of beetles, mostly in the families Ptiliidae, Pselaphidae, Scydmaenidae, Histeridae, and Staphylinidae, but these are characteristically present in large numbers (Suter, Wenzel, Wagner, personal communications). There may be further genetic advantages to parthenogenesis in such large populations established by single founders. A closely inbreeding bisexual population, derived from a

single fertilized female, provides the conditions for increasing homozygosity and the expression of deleterious recessives, and may thus result in a lower level of fitness of the population.

A similar pattern of a southern insect maintaining itself in favorable microhabitats in northern localities—again in sawdust piles—is seen in *Zorotypus hubbardi* (order Zoraptera). The distribution of this species has been worked out in detail by Gurney (1959), Riegel and Ferguson (1960), and Riegel (1963). In the southern states of Florida, Mississippi, Louisiana, and South Carolina, this species occurs under the bark of stumps and in logs; but in most of its recorded range, which extends north to Delaware and Pennsylvania in the east, and Iowa, Kansas, and Oklahoma to the west (see map in Riegel, 1963), it occurs almost exclusively in sawdust piles. For example, of 34 collections in eight states outside the Gulf states region, all but one were from sawdust piles (Riegel and Ferguson, 1960), and Riegel (1963) believes that the species can maintain itself in the north only by chance colonizations of temporarily favorable sawdust heaps.

Finally, it has been shown that *Eurygyne intricata*, in contrast to all the other species described in this paper, is strongly polymorphic with respect to the number of marginal hairs of the metathoracic wings (figs. 9, 11). Since the marginal hairs account for much the greater part of the expanse of the wing, it is highly probable that the individuals with great reduction in marginal hairs are unable to use their wings for passive dispersal. Of 107 specimens of *intricata* studied, 7 or 6½% had a full complement of marginal hairs (an average of 50 in the apical group) while the rest showed an extreme but variable degree of reduction. This suggests a balanced polymorphism resulting from conflicting selective forces (for recent reviews see Mayr, 1963, and Ford, 1964). The polymorphic population of *intricata* was collected on South Bimini Island in the Bahamas. The island is only 4 by 1¾ miles in extent, has a low relief, and is subjected to prevailing southeast breezes during the summer when the collections were made (Vaurie, 1952). Under these circumstances there is probably strong selection against fully-winged individuals because of the hazard of being wafted out to sea and lost.¹ On the other hand, there is undoubtedly need for dispersal between habitats on the island and between islands from time to time, hence selection

¹ Since this was written, a comparable situation in wind-dispersed seeds has been reported by Carlquist (1966). In the seeds of certain mainland Compositae, the pappus is well developed and functions for aerial flotation, while in related Pacific island species, the pappus is greatly reduced, with correspondingly diminished powers of dispersal.

for some fully-winged individuals in the population. When other populations of *intricata* are discovered, it will be of interest to compare the degree of polymorphism of the wings with reference to the habitat.

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